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Sebastian Lindberg

# **Sustainable Lean production model through alliance model in food industry**

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**UNIVERSITY OF VAASA****School of Technology and Innovations****Author:** Sebastian Lindberg**Title of the Thesis:** Sustainable Lean production model through alliance model in food industry**Degree:** Master of Science**Programme:** Industrial Systems Analytics**Supervisor:** Josu Takala**Year:** 2021 **Number of pages:** 89

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**ABSTRACT:**

In today's environment, the food industry is a hot topic facing continuous challenges, which creates a need to quickly adapt to different changes and demands and apply continuous improvement to its manufacturing processes. The SME businesses in the food industry are facing hard competition, and therefore, it puts pressure on creating new methods that contribute to increased sustainability in the industry as well as gaining competitive advantage from an economic perspective. The aim of the research was to examine the creation of sustainable solutions with Lean principles from a small and medium-sized (SME) approach, a combination of Lean and green collaboration methods. Lean production models such as 5R, DMAIC, and DLL are examined, and the benefits of those models in the SME food industry. As a secondary objective, this research focused on how to create more sustainable value to a product from a Lean and Green thinking approach. The research was done by gathering data on a survey with food producers and retailers. Interviews with food producers and retailers were also held. Results showed that there was a huge interest in additional digital solutions to improve the food production and distribution chain. The results also found barriers in bureaucracy and conflicts between different rules as a bottleneck in achieving full efficiency in the food production and distribution chain. The survey participants stated that the cooperation between food producers and retailers should be improved, and to reduce the food storage amounts, this to grant more fresh products, and this action would also minimize waste. New solutions in the distribution chain were presented, such as a flexible application that could be used for the transport of different products in the food production and distribution chain.

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**KEYWORDS:** Lean production, Sustainability, Food industry, Manufacturing process, SME

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## Contents

1	Introduction	10
1.1	Background and purpose of the study	10
1.2	Research problem	11
1.3	Research design and scope	11
1.4	Structure of the research	12
2	Literature review	13
2.1	SME in food processing enterprise	13
2.2	Lean manufacturing	14
2.2.1	Lean principle	17
2.2.2	Lean in food industry	19
2.2.3	Lean for SME in food industry	21
2.2.4	Lean manufacturing in SME food industry	23
2.2.5	Lean management in SME food process chain	24
2.2.6	Mitigation of food loss in SME	25
2.2.7	Continuous improvement of fresh food logistics chain	29
2.3	Sustainable Lean and food industry	31
2.3.1	Sustainable Lean principle	35
3	Method	37
3.1	Research context and mechanism	37
3.2	Research method	38
3.3	Survey and interview	38
4	Results	39
4.1	General data and production overview	39
4.2	Factors and impacts affecting the food production and distribution chain	48
4.3	Sustainability in food supply chain and delivery	59
4.4	Interview with food producer and retailer	69
5	Conclusions	72
	References	75

Appendices	87
Appendix 1. Interviewed persons	87
Appendix 2. Questionnaire: Minimization of food waste and development of the producer-consumer chain	88

## Figures

Figure 1. Dynamic Proximities support the resilience, creativity, and development of SMEs (Brink, 2018).	14
Figure 2. A Platform of DMAIC and DLL (Costa et al., 2021).	16
Figure 3. A diagram illustrating the connection between lean and environmentally friendly activities (Caldera et al., 2017).	18
Figure 4. Sustainable strategic assets structural mechanisms (Forrester et al., 2010).	19
Figure 5. A methodology for deploying Value-Stream Mapping also for the purpose of assessing loss in the industrial food distribution chain (Folinas et al., 2013).	21
Figure 6. Form of theoretical analysis (Costa et al., 2020).	23
Figure 7. The enablers of Lean thinking in a green perspective (Oliveira et al., 2018b).	24
Figure 8. Grocery retail waste control is a 5R solution to generating sustainable demand (Huang et al., 2021).	28
Figure 9. Production Distribution to Compatible Sectors (Villalobos et al., 2019).	30
Figure 10. Performance model for Food cold chain (Shashi et al., 2018).	31
Figure 11. The Green Lean Six Sigma model (Kaswan & Rathi, 2020).	32
Figure 12. Interdependence between sustainable Lean factors (Martínez-Jurado & Moyano-Fuentes, 2014).	33
Figure 13. Survey participant's position in the production chain.	39
Figure 14. The Business structure of the survey participants.	40
Figure 15. Number of workers in the survey participants companies.	41
Figure 16. Type of products that the survey participants produce.	42
Figure 17. Production frequency of survey participants companies.	43
Figure 18. Delivery frequency of the survey participants operating companies.	44
Figure 19. Distribution methods of the survey participant companies.	45
Figure 20. Sales channels of the participant's food companies.	46
Figure 21. Preferred communication channels among the survey participants food companies.	47
Figure 22. National rules on food safety among the survey participant food companies.	48

Figure 23. Impact of EU rules on food safety among survey participants.	49
Figure 24. Impact of labeling the products among survey participants.	50
Figure 25. The conflict between different rules on the organizational governance among the survey participants.	51
Figure 26. Demand variation effect on the organizational activity among the survey participants.	52
Figure 27. Impact of price fluctuations in the food industry among the survey participant's businesses.	53
Figure 28. Competition with retail chains impacts food production and distribution chain among the survey participants.	54
Figure 29. Factor distribution on transport costs among the survey participants.	55
Figure 30. Impact factor on marketing and communication among the survey participants.	56
Figure 31. Impact factor of the limited access to the market among the survey participants.	57
Figure 32. Impact factor regarding lack of computer technology knowledge and support among the survey participants.	58

**Tables**

Table 1. Duration time of food products. ....	59
Table 2. Delivery amounts. ....	60
Table 3. Product storage possibilities. ....	61

**Abbreviations**

SME	-Small and medium-sized enterprise
DMAIC	-Define, Measure, Analyse, Implement, Control
DLL	-Double Loop Learning



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# **1 Introduction**

In this chapter background and purpose of the study is presented, including research problems and research question, including the scope and objectives of the research, including the entire structure of the thesis.

## **1.1 Background and purpose of the study**

Lean company theory is also one of the latest influential fields of study, including supply chain management; nevertheless, a scarcity of studies on Lean in smaller businesses (Hu et al., 2015).

Clients are continually pressuring businesses of all sizes including industries to increase the profitability of their commodities (Shokri et al., 2016).

Potential customers, legislators, academics, agricultural processors, or retailers are now becoming more concerned about the long-term viability of food supply chains. The significant growth including its fast food supply chain often confirms such concern (Paciarotti & Torregiani, 2021).

The development of core competencies for businesses is among the key goals of method design and execution (Forrester et al., 2010).

While eco-efficiency is recognized as an effective method for evaluating a corporation's ecological and financial issues at the same time, certain adaptation strategies implemented to green and lean advantages get the reverse impact on a corporation's ecological and economic results (Carvalho et al., 2017).

Development is essential for the sustainability, success, and value proposition of businesses, and then it fuels economic stability (Solaimani et al., 2019).

## **1.2 Research problem**

Businesses of smaller and larger size in the food category face obstacles in fresh food logistics chain, how to minimize waste, and to gain more sustainable value to its core competencies. The research will focus on sustainable Lean production through an alliance model in the food industry to combine Lean and green thinking and aim for the case company to achieve full Lean and sustainability, which gives the case competitive an advantage versus similar competitors. Research question to be answered:

**RQ1:** How to add more sustainable value to a product?

## **1.3 Research design and scope**

The thesis research concerns the food industry sector, creating sustainable solutions using Lean principles, improving the logistics chain from supplier to end-user from a Lean and green thinking perspective. The study is made from a small and medium-sized enterprise approach. This research aims to help case company to minimize food waste and, at the same time gaining economic benefits.

The study is conducted using qualitative research, figures, tables, and supplier survey. Qualitative research is chosen because it is the most suitable for this type of study. To achieve accurate results, the study collected and analysed scientific articles of the research area, and in addition, a supplier survey will be done and analysed, which aims to help the case company to take appropriate actions in the company governance.

The survey was tested on one of the suppliers first to ensure it gives results in the desired manner before entering the main phase.

## **1.4 Structure of the research**

This thesis is organized as follows: The first chapter gives the reader an overall picture of the study, including its research problem and research design, including the scope of the study. In the second chapter, a Literature review is presented, the third chapter presents the methodology, and the fourth chapter presents the results, and chapter 5 the conclusions.

After the first chapter literature review presenting the scientific data of today's small and medium businesses and their aspect. The third chapter describes the methods conducted in this research, and chapter four presents the results of the study. Finally, chapter five concludes the research and takeaways.

## **2 Literature review**

### **2.1 SME in food processing enterprise**

Lean manufacturing has now been recognized as a business style that promotes organizational effectiveness. Lean manufacturing has been recognized as an inclusive management style that improves organizational efficiency by creating values for manufacturing operations by reducing waste in terms of time, commitment, and material. Numerous efficiency through enhancing production operations by the elimination of waste, time, and commitment, small and medium-sized companies worldwide adopt or are able to accept lean programs in order to compete in today's demanding market (Mohammad & Oduoza, 2019).

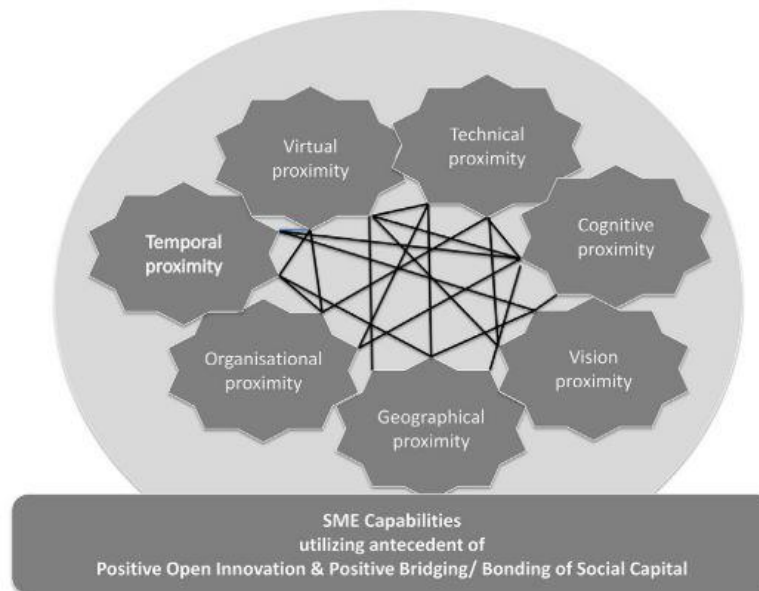
Solid networks of Small and Medium-Sized businesses are critical for creativity and development in contemporary Europe (Brink, 2018).

Food sellers are under commitment to improving their inventory levels. As a result, improved stock management, commodity consistency, and cost are made possible (Jie & Gengatharen, 2019). The exchange of expertise among food startups and their suppliers or customers fosters innovation (Török et al., 2019).

Legislators and professionals in every organization, even small and medium-sized businesses, are constantly confronted with the task of assessing which range of tools and methods to use to achieve benchmark performance across both technical and environmental areas, how to develop a holistic, intelligent framework that results in exceptional system results, as well as how to analyze the resulting benefits. As a result, there is an immediate need to discuss concerns around the integration of lean and green paradigms, as well as regular performance evaluation to identify areas for change (Thanki et al., 2016).

When organizations get softer, the position of middle managers will switch focus from people management and into more specialized tasks needing better credentials (Horváth & Szabó, 2019).

Additionally, all SMEs stress the importance of their own capabilities and agency initiatives on new ideas and the capability to collaborate with other partners on whatever ideas emerging for success which is depicted in Figure 1 underneath (Brink, 2018).



**Figure 1.** Dynamic Proximities support the resilience, creativity, and development of SMEs (Brink, 2018).

Dynamic Proximities map would be a great working model for the case company since active collaboration between stakeholders is essential, and it brings data that can be utilized for developing and making the processes more efficient in the case company.

## 2.2 Lean manufacturing

In today's that diverse environment, a lean and productive business organization has become critical. Numerous businesses have launched initiatives and projects in recent

years to implement Lean manufacturing practices, with the goal of reducing non-value-added processes and aligning the value stream with the customer (Rauch et al., 2017).

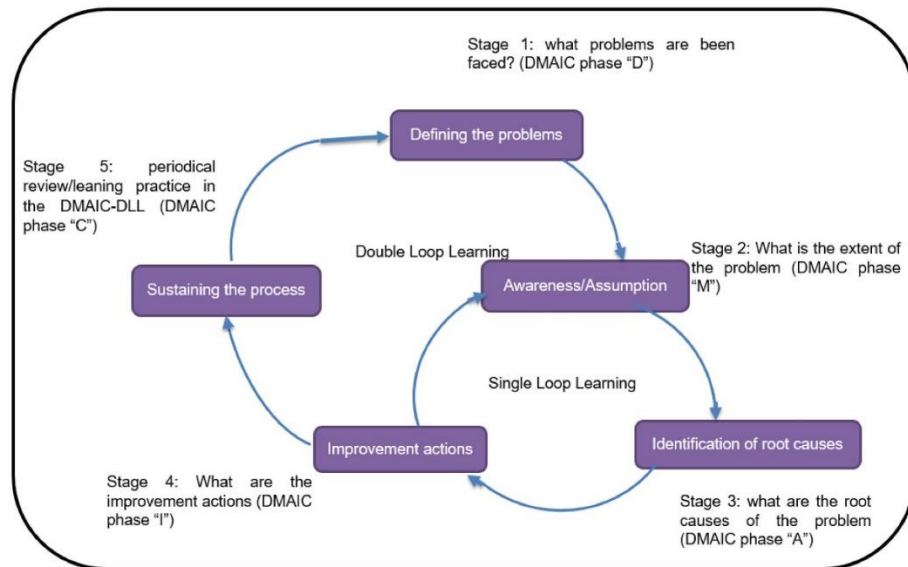
Employee engagement, adequate preparation, and senior leadership engagement are essential to the implementation of lean manufacturing techniques (Dora et al., 2014).

To manufacture specific goods, it is necessary to be able to react rapidly to consumer requests about physical characteristics: that item's proportions and content composition. Lean production techniques, such as Single-Minute Exchange of Dies, push for shorter setup times and increased manufacturing versatility (Kolla et al., 2019).

Achieving lean deployment success needs the commitment and attention of all stakeholders of the organization, manufacturers, vendors, and consumers (Burawat, 2019). There is a shortage of well-defined and appropriate metrics for lean and sustainable production (Hartini & Ciptomulyono, 2015).

A customized plan is required, taking into account not only from the goals of the organization, as well as the various resources that will be utilized among each lean project and the soil's leanness standard (Sartal et al., 2018).

Although DMAIC and DLL have mutual objectives, sometimes it is often used to foster organizational development, whereas the previous foster performance improvement practices, which can be seen in Figure 2 below (Costa et al., 2021).



**Figure 2.** A Platform of DMAIC and DLL (Costa et al., 2021).

Research conducted suggest case company implement DMAIC and DLL to achieve full Lean and to maintain continuous improvement; nevertheless, it is an essential tool for adding more sustainability to case company's products.

Lean manufacturing is not a formula or a miracle cure, but a powerful method for finding low-value items in any packaging sector and attempting to minimize or remove them in order to increase production or benefit (Palange & Dhattrak, 2021).

Executives can prioritize resource-based approaches in order to create a long-term capacity for implementing innovative strategies (Hao et al., 2021).



### **2.2.1 Lean principle**

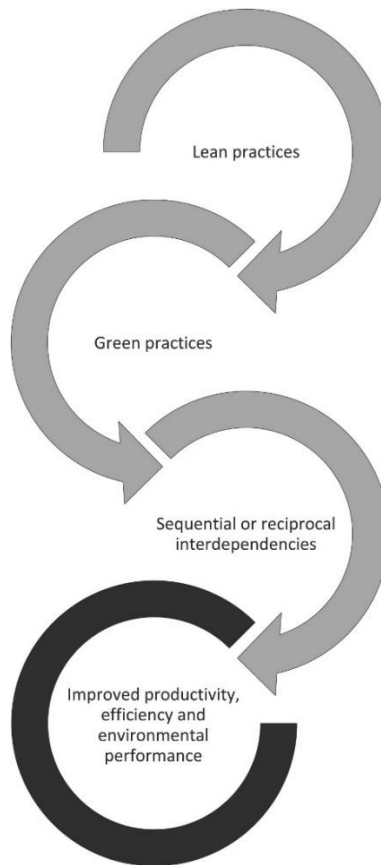
Lean thinking began with the introduction of the Toyota Production System, which Taiichi Ohno and affiliates designed to aid Toyota's sustainability during the reconstruction healing process due to management and capital restraints (de Freitas et al., 2017).

Within internationally dynamic economies, lean technologies are used to coordinate manufacturing processes in order to maximize economic efficiency. To put it another way, the lean manufacturing philosophy seeks to maximize sustainability, grow markets, and enhance organizational efficiency (Soltanali et al., 2021).

Lean Six Sigma is renowned for its ability to develop rapid-results development plans that ends in real big business financial outcomes. Productivity and efficiency may be measured using Six Sigma criteria in terms of a community that is more receptive to quality management with the goal of minimizing commodity errors per million of openings, maximizing process capacity, and eliminating process variance (Besseris, 2014).

When an organization is operating in a competitive atmosphere and its workers are completely resistant to reform, the first move toward implementing a lean strategy would be a quest for employee participation, even if this does not require the use of traditional lean tools (Mascarenhas et al., 2019).

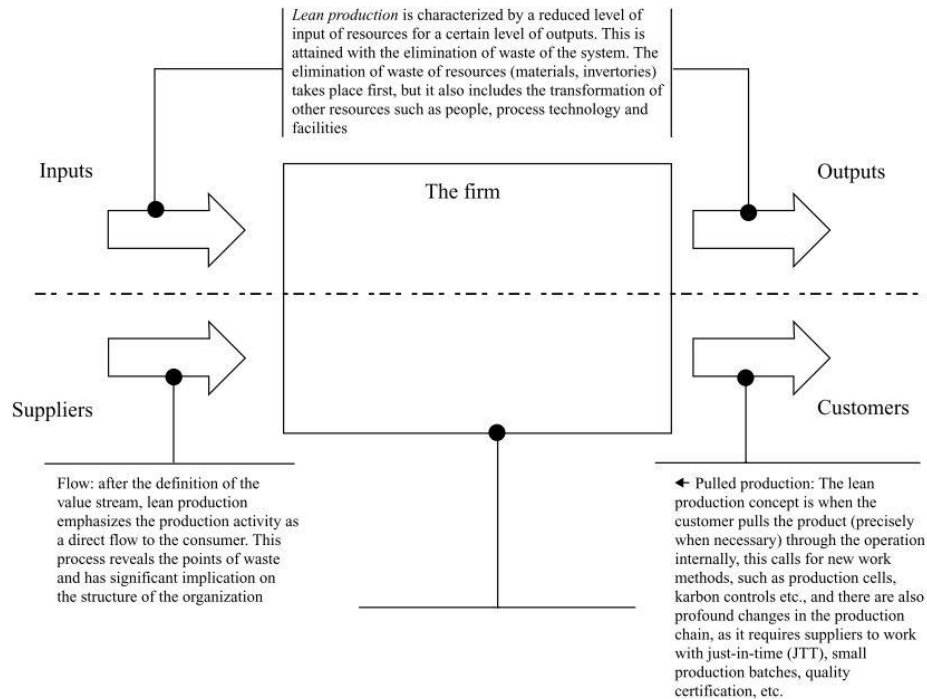
Lean and green philosophy seeks to eliminate waste by quality change, which can include the usage within one or many application of lean practices illustrated below in Figure 3 (Caldera et al., 2019).



**Figure 3.** A diagram illustrating the connection between lean and environmentally friendly activities (Caldera et al., 2017).

According to research combining Lean thinking and Green practices, it will result that case company improve their organizational culture and sustainable value thinking but also at the same time gaining additional competitive advantage.

The following Figure 4 examines Lean manufacturing and the implementation of lean thinking among the organisations related stakeholders (Forrester et al., 2010).



**Figure 4.** Sustainable strategic assets structural mechanisms (Forrester et al., 2010).

For the case company to achieve complete Lean certain procedures and structures should be applied, such as strategic structural mechanisms between the case company and suppliers and other related stakeholders for improving the supply chain, value stream, and work methods.

### 2.2.2 Lean in food industry

Currently, numerous methods exist for dealing with variance in food manufacturing, no procedure has been introduced for examining the varied levels of variation among various workstations in food stream processing applications (Noorwali, 2013).

Implementing the versatile Lean Six Sigma approach within food sector could uncover many prospects for quality and process change (Besseris, 2014).

Value chain management necessitates a new business philosophy, one through which earnings are increased by collaboration rather than by the right to manipulate the competition or exercising influence over customers and suppliers (Taylor, 2006).

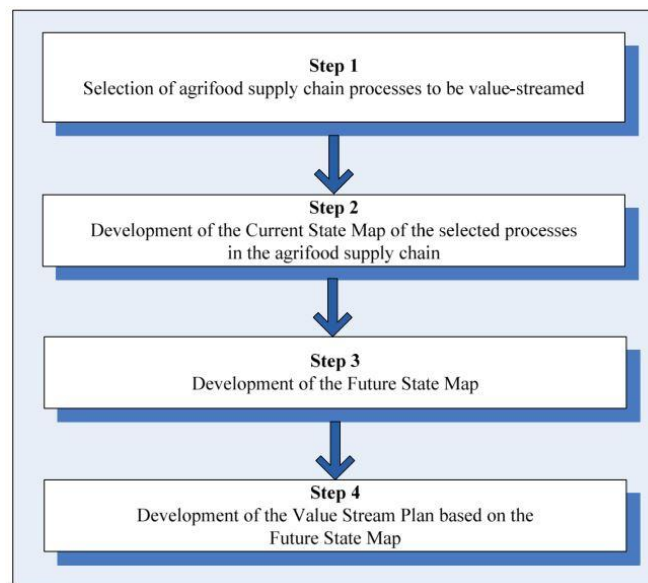
Using the information and experiences from its studied research study, realistic solutions are identified for improving product design efficiency while reaching lean objectives such as increased quality, decreased waste, and shortened process improvement lead time (Tyagi et al., 2015).

Successful execution of a green supply chain efficiency, complemented by concurrent adoption of Lean governance (Cherrafi et al., 2018).

According to data review, absorptive knowledge capability is a good indicator of sustainability capacities and implementation of green innovations (Aboelmaged & Hashem, 2019).

Following a series of studies, a process procedure for calculating loss in the agriculture distribution chain is suggested. The proposed solution makes use of Value Stream Mapping, a fundamental method in Lean thinking.

The authors claim that VSM assessment is a powerful and productive method for a variety of changes, not only for waste detection but also for determining the agriculture distribution chain's environmental sustainability, illustrated in Figure 5 below (Folinas et al., 2013).



**Figure 5.** A methodology for deploying Value-Stream Mapping also for the purpose of assessing loss in the industrial food distribution chain (Folinas et al., 2013).

There are numerous philosophical ideas for modern or expanded approaches within lean production literature which require methodological validation (Adlin et al., 2020).

### 2.2.3 Lean for SME in food industry

Sustainable corporate practices are an ambition for a growing number of small and medium-sized businesses worldwide, promoting sustainability, stability, and constructive effects on the environment. Lean thinking has become a common management method for small to medium-sized businesses as a means of achieving sound manufacturing practices while still meeting the need for increased output productivity and waste management (Caldera et al., 2019).

The preceding analysis suggests that factors like coordination among management and staff, a well-defined approach, the need for staff who can lead Kaizen adoption within an organization, having adequate expertise, and rewarding staff with a certain degree of autonomy are critical for an effective Kaizen implementation (Maarof & Mahmud, 2016).

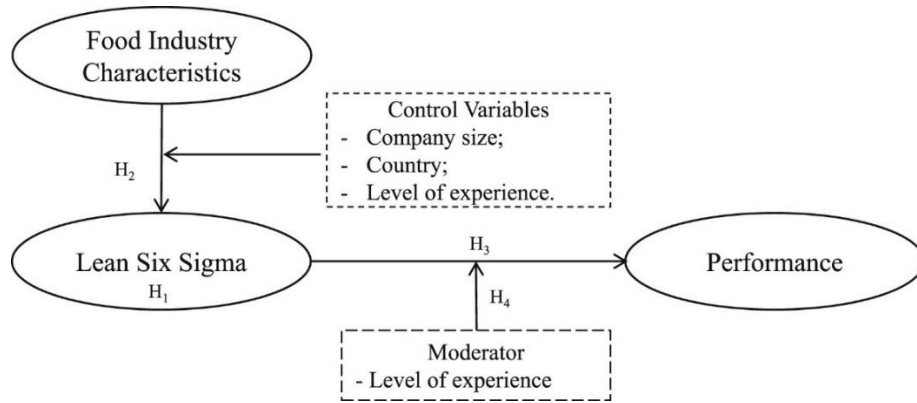
Likewise, the position of engineering is expanding in terms of implementing, quantifying, funding and maintaining smart energy for small and medium-sized businesses as well as major industries (Seth et al., 2018).

While automation, digitization, and cyber-physical technologies have been introduced, humans continue to play a critical role in preparing, developing, and integrating new manufacturing systems and factories. Numerous business industries would face a shortage of qualified labor. Small to medium-sized businesses, in particular, have significant difficulty recruiting highly qualified workers (Matt et al., 2020).

Research demonstrates that considering the diverse interdependence of ecosystem participants, perceptions of what creativity and expertise cooperation entail will vary significantly. This may be explained by the distinctions among small and medium-sized value chains, which together comprise the ecosystem paradigm of value generation and acquisition (Radziwon & Bogers, 2019).

The methods and strategies are the organizational means for developing innovative technologies in a lean and environmentally sustainable environment.

The beneficial impact of Lean and Six Sigma methods on food processing industry success is counterbalanced by skill level, with the beneficial effect becoming stronger with more expertise which is illustrated in the Figure 6 below (Costa et al., 2020).



**Figure 6.** Form of theoretical analysis (Costa et al., 2020).

#### 2.2.4 Lean manufacturing in SME food industry

Food small and medium-sized businesses place higher importance on food protection and product quality than on the development process (Dora et al., 2013). Each day, small businesses face stiff rivalry from foreign economies and rising consumer expectations. Numerous multinational corporations are introducing lean production to adapt to such new circumstances (Elkhairi et al., 2019).

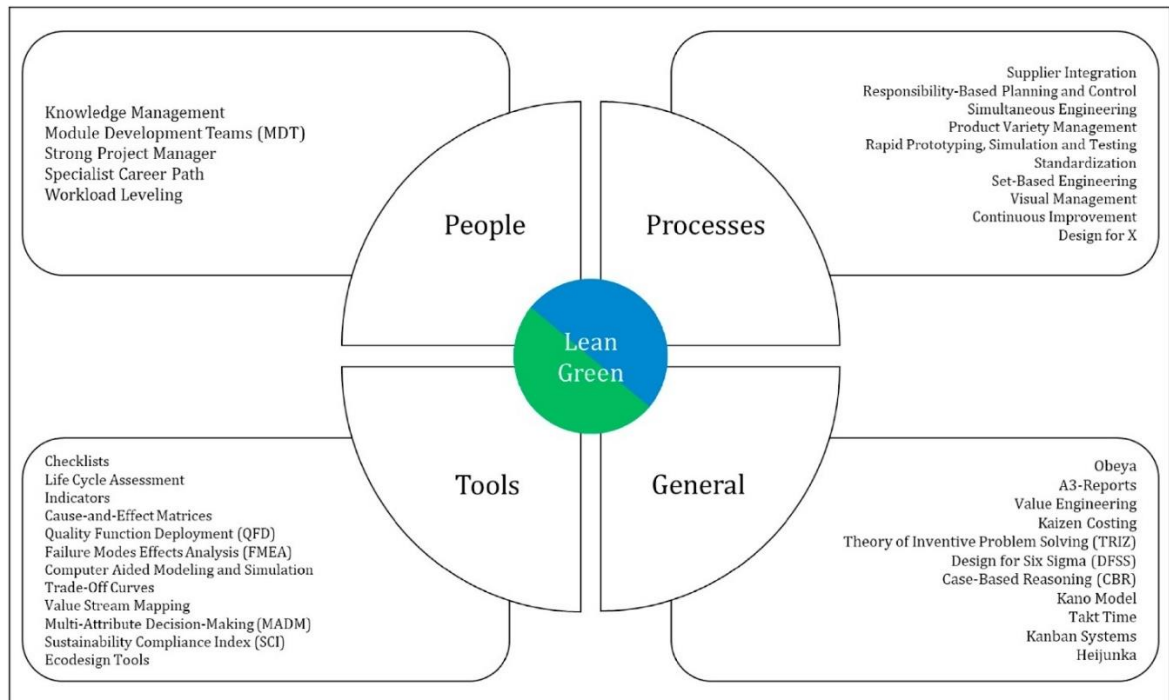
Green lean production is a continual method of change. Benefits to small-scale manufacturing and government-led initiatives to promote renewable technology are potentially the other path to promote an increasingly effective environmental economy (Nallusamy et al., 2015).

A commercial model's central tenet is to toughen consumer demands by identifying how the company provides value to consumers, attracts customers to pay for value, and converts purchases into sales (Faria et al., 2021).

To satisfy market needs, manufacturers inside the food sector must find appropriate innovative manufacturing techniques (M. H. Ali & Suleiman, 2016).

Mostly as a result, it would be critical to increase executives understanding, expertise, and specialized preparation on sustainable development in Small and medium enterprises (Aboelmaged, 2018).

Limiting value creation to Small and medium enterprises, as identified value stream mapping and a structure for Lean and Green modeling as a competitive approach for smaller firms, illustrated in Figure 7 below (Oliveira et al., 2018a).



**Figure 7.** The enablers of Lean thinking in a green perspective (Oliveira et al., 2018b).

### 2.2.5 Lean management in SME food process chain

Small businesses are mostly neglected in Lean Management study for a significant period of time, and specialized studies on this subject have been few and far between (Rauch et al., 2017).



Fundamental qualities such as integrity, trust, fairness, fidelity, reliability, righteousness, and reverence cannot be overlooked, and resolving these facets of culture must be prioritized to foster senior management engagement and overcome opposition to shift (Shokri et al., 2016).

It is discovered that implementing a more formalized and comprehensive preparation and coordinating process that is segmented by commodity and client results in increased effectiveness. Additionally, operating productivity was increased as a result of decreased inventory volumes, commodity range rationalization, and weekly leveled preparation (O'Reilly et al., 2015).

Due to accelerated globalization and intensified competitiveness, Small and medium enterprises' management tactics must be refocused and redesigned. That is also important in order for them all to sustain and improve their current market and business success while retaining comparable or reduced operating costs (Y. Ali et al., 2020).

#### **2.2.6 Mitigation of food loss in SME**

Food waste is undoubtedly a dynamic problem with a plethora of variables that can be viewed from a variety of angles. On the other side, users have additional incentives to reduce food waste, including financial savings and legal concerns over equity (Cane & Parra, 2020).

Numerous aspects of food processes should be changed to reduce negative environmental consequences. A critical factor that has gained increased focus is the elimination of food waste. When food is lost, energy is often consumed in agriculture, shipping, manufacturing, food sales, packaging, planning, and quality management practices all through the distribution chain (Stangherlin et al., 2019).

It is essential to mention that reducing food waste is a tool for enhancing food production, reduce poverty, economic prosperity, and protecting the environment and that strategies can prioritize the greatest potential benefits (Bharucha, 2018).

With the disease outbreak of covid-19 putting immense strain on the food processing market to reduce costs, and global leaders pushing for a sustainable new agreement, food waste elimination provides an ideal approach since it addresses multiple purposes (Vizzoto et al., 2021).

Biomass implementation to improve biogas of wasted food has enormous potential for business production of biofuel to meet future energy demand (Ambaye et al., 2021).

What's especially noteworthy is that extremes of wasted food exist in both wealthy and poorer countries and cities. It means that efforts to significantly reduce retail organic waste at the global level would include all communities (Dou & Toth, 2021).

Startups should be able to open up their critical and entrepreneurial thought in order to build intellectual networks and strengthen their perceptions regarding sustainability, thereby benefiting their companies (Santoro et al., 2020).

International competitiveness has resulted in developments such as product growth with a shortened and more unpredictable lifespan. Consumers and inventions with groundbreaking approaches that need swift action and cost reductions have grown exponentially around the world (Ghobakhloo & Ching, 2019).

Food loss levels derived from material movement analyses are typically higher than those derived from waste, these distinctions are more pronounced at the main development and manufacturing food chain (Caldeira et al., 2021).

Reduced food loss can be a premium strategy for addressing global warming, not to consider the other co-benefits associated with pollution mitigation. Additionally, our study reaffirms the importance of implementing several measures to substantively minimize organic waste (Read & Muth, 2021).

The contemporary culture is becoming associated with difficult and complicated food supply chains. Assuring food consistency is maintained throughout the distribution network, through development to use, is critical again for the chain's long-term sustainability (Kakadellis et al., 2021).

Waste management and the function of manufacturing in minimizing waste are not just a food problem but also a recycling, environmental, sustainable manufacturing, and environmental concern (Brennan et al., 2021).

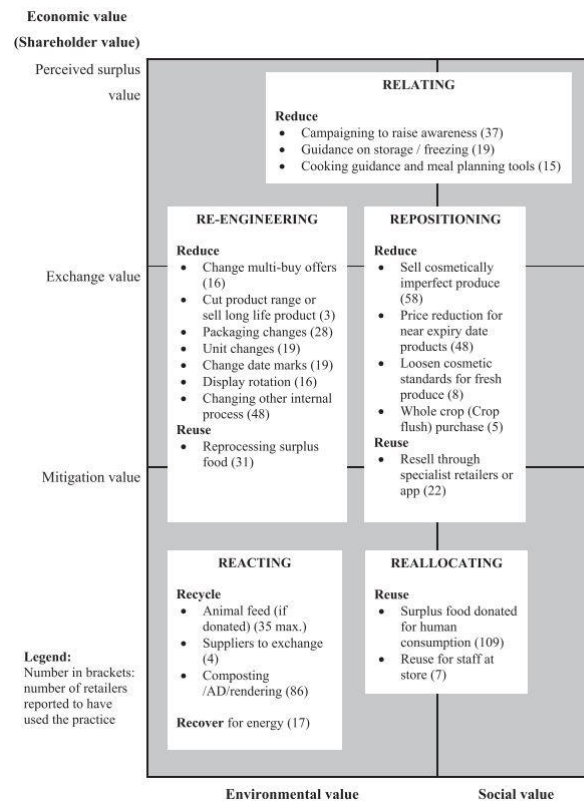
A Circular green economy enables more efficient and sustainable usage of organic energy (Sharma et al., 2021)

Small and medium enterprises can keep trying to figure with the collaborative values, such as collective decision, information exchange, network hub, and common vision, that representatives of a supply chain management must acquire in order to achieve accurate and timely exchanges, capital, expertise, and activities in order to provide the highest product at the lowest possible cost and time, thus the quality and productivity of digital marketing. Big data has risen to prominence as a critical tool for output enhancement and record-keeping (Annosi et al., 2021).

Although others argue that this allows recognition of where food gets wasted throughout the value chain, it does not often address whether and in which direction food is wasted throughout a production chain (Richards et al., 2021).

A green food waste reduction framework is needed to ensure adequate processing, distribution, and use of discarded food for renewable energy (Ananno et al., 2021).

The following Figure 8 below illustrates a classification system of 5R methods to consumer food waste management strategies within a context of environmental value. They are classified as realignment, redirecting, responding, redesigning, and related in this section (Huang et al., 2021).



**Figure 8.** Grocery retail waste control is a 5R solution to generating sustainable demand (Huang et al., 2021).

Employees and management reported making discard decisions based on subjective judgments of potential palatability rather than on corporate policy, which sometimes resulted in worry over how to properly minimize waste (Ceryes et al., 2021).

### **2.2.7 Continuous improvement of fresh food logistics chain**

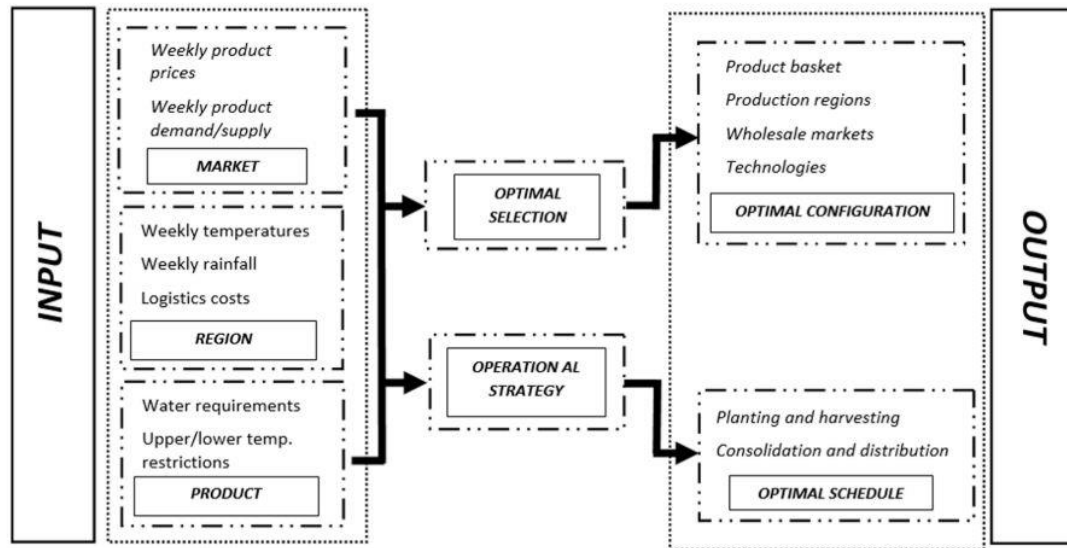
Public understanding of food protection and regulatory controls on food safety has accelerated the growth of food supply chain management dramatically in recent years.

For temperature-sensitive and perishable food goods, significant progress has been made in the food cold chain, which encompasses the processing, storage, and delivery of items that require any degree of temperature or environment regulation to maintain their important elements and rate (Chen et al., 2018).

Fresh fruits and vegetables are nutritious due to their temperature sensitivity. The challenge of maintaining the nutritious, hygienic, and aesthetic characteristics of fresh foods during transportation creates a direct issue where perishability must be managed in ways that do not often conform to the conventional understanding of atmospheric procedures (Hsiao et al., 2018).

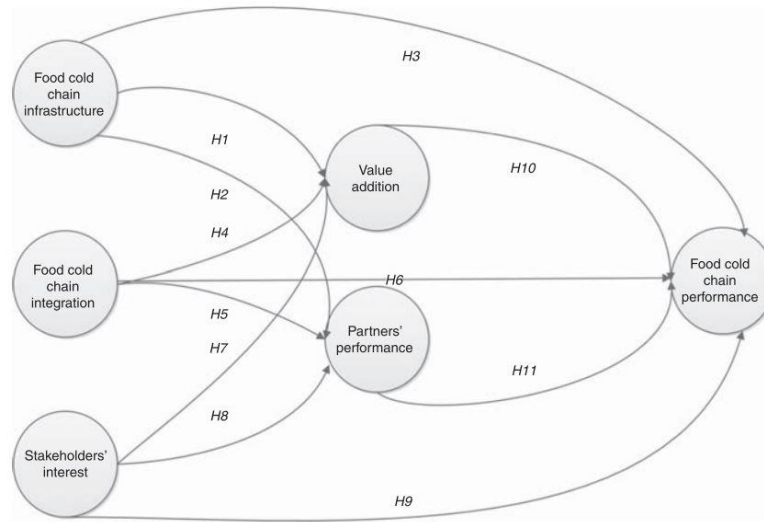
An illustration of frameworks that answer, at the strategic stage, and resources distribution methods centered on information generated by various innovations, the figure depicts an increased view of the issue presented by these authors.

Another of the problems discussed in these projects is the distribution of defined economic opportunities to sectors where output schedules balance one another, allowing for year-round supply illustrated in the Figure 9 below (Villalobos et al., 2019).



**Figure 9.** Production Distribution to Compatible Sectors (Villalobos et al., 2019).

Figure 10 below outlines the conceptual architecture, which is comprised of five components: food cold chain technology, food cold chain incorporation, stakeholder engagement, quality enhancement, and collaborator efficiency (Shashi et al., 2018).



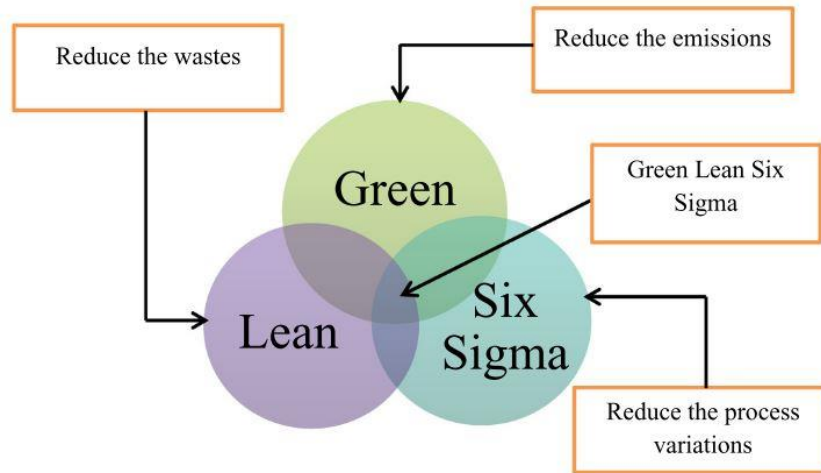
**Figure 10.** Performance model for Food cold chain (Shashi et al., 2018).

Waste may be avoided in the form of fresh products with a limited shelf period by ensuring that the commodity meets the market in ideal condition and with the full expiration dates. On another side, surplus avoidance is crucial for improving the distribution chains efficiency (Kaipia et al., 2013).

### 2.3 Sustainable Lean and food industry

Environmental Lean Thinking is an environmentally sustainable solution that reduces environmental footprint when producing high-quality materials. An optimized solution is needed that minimizes waste, heterogeneity, and pollution of the environment.

Green Lean Six Sigma is an all-inclusive methodology for reducing sustainable pollution; The Green Lean Six Sigma model can be structured as shown in Figure 11 (Kaswan & Rath, 2020).



**Figure 11.** The Green Lean Six Sigma model (Kaswan & Rath, 2020).

Numerous researchers have examined the use of lean production in lean innovation and sustainable growth through observational study and review at the business level, as well as the process, paradigm, and structure (Cai et al., 2019).

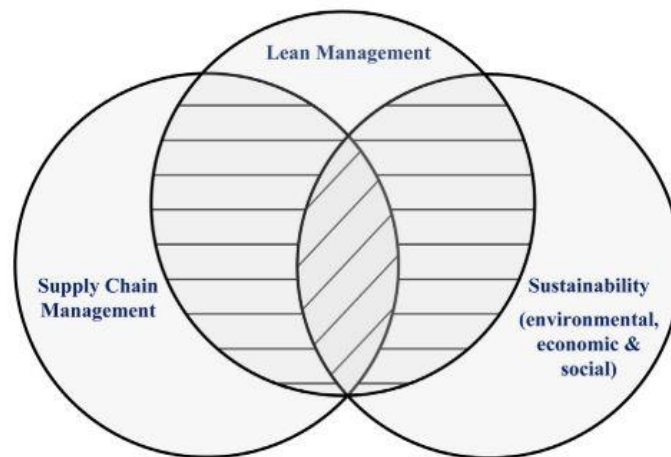
There is no denying that environmental sustainability is compatible with a sustainable future (Dhingra et al., 2014).

Numerous research published in the last few years have shown that lean management may play a critical role in achieving sustainability (Muñoz-Villamizar et al., 2019).

The commercialization of new biomaterials would ensure the protection and consistency of food goods while lowering prices and the production (R et al., 2021).



To fulfil the targets set, within review of relevant research on Lean Management, Supply Chain Management, and Sustainability was undertaken, explained in Figure 12 below (Martínez-Jurado & Moyano-Fuentes, 2014)



**Figure 12.** Interdependence between sustainable Lean factors (Martínez-Jurado & Moyano-Fuentes, 2014).

If the effects of global warming, peak oil, and food shortages grow more prominent, food pollution is destined to become one of the twenty-first century's main ecological and sustainability justice challenges (Miroso et al., 2016).

There are about 310,000 firms in the European food sector, with 99 percent being small and medium-sized businesses. The food industry plays a critical role in meeting market demands, contributing more than 600 billion euros to the EU economy each year. In the food sector, logistics and supply chain management are vital (Manzini & Accorsi, 2013).

Increased consumer demand for constant food quality control and expiry date extension has resulted in the development of new models of packaging solutions such as smart packing and active packaging techniques (Soltani Firouz et al., 2021).

First from the point of view of economic executives, demonstrate that menu planning and purchasing, food handling and cooking processes, conscientious water use during

preparing meals and sanitation, including the use of sustainable energy, both have an effect on the food energy and water sectors, decreasing the amount of food waste and, therefore, the use of natural resources (Rosa et al., 2021).

Smart applications can facilitate cooperation among various stakeholders, resulting in improved food supply output that supports environmental sustainability growth (Singh et al., 2019).

Current bibliographic data indicates that industrial companies may accomplish an exchange among organizational and sustainable efficiency (Viles et al., 2021).

Additionally, empirical findings indicate that eco-innovation users adhere to more environmental regulations conservation policies and also that their financial and environmental efficiency is improved as a consequence of eco-innovation (Geng et al., 2021).

For instance, the role of continuous improvement or profitability appears to be significant success drivers for the survival of a business model in many other competitive sectors and environments (Long et al., 2018)

Through reviewing interdisciplinary information from various fields such as environmental and development management, innovation management, and analysis on small and medium-sized businesses, the framework enables the integration of formerly fragmented expertise and the explanation of contingencies in an expanded taxonomy of sustainable development practice. There is undoubtedly a skills difference in the food industry. While it is a recurring debate, advancements in technology and creativity would widen the divide, necessitating the development of innovative methodologies and strategies that promote the upgrading of the established labour force (Lazaro-Mojica & Fernandez, 2021).

The findings clearly argue towards CE-based executive training programs that should be planned and personalized twice a year, with the aim of motivating workers to raise their knowledge of sustainable strategies (Jinil Persis et al., 2021).

### **2.3.1 Sustainable Lean principle**

Various and emerging methods to sustainable corporate activity include environmental protection schemes, regulations, auditing, monitoring, civil action, and risk evaluation. Lean thinking is another new strategy that has the ability to significantly improve a company's effectiveness by integrating and aligning sustainable management practices (Caldera et al., 2017).

Since lean production, productive activities became the latest conceptual framework. Quality assurance philosophy can be characterized as an evolving phenomenon of integrating the three viewpoints of financial, ecological, and socioeconomic stability (Martínez León & Calvo-Amodio, 2017).

The potential alternative makes use of Value Stream Mapping, a fundamental method in Lean thinking. The authors claim that value stream mapping research can be an important and productive method for a variety of changes, not just for identifying wastes but also for determining the agriculture supply chain's greening (Folinas et al., 2013).

Leadership development via Gemba walking and diagnostic solutions appears as a crucial component in implementing Lean Production and sustaining the growth and the development (Powell & Coughlan, 2020).

The research and findings demonstrated that lean and sustainable development innovation solutions would contribute to achieving sustainability (De et al., 2020).

According to the study findings, coercive emerging technologies push a business toward a transformative commitment to achieving, while explorative innovations accelerate a business toward a truly revolutionary commitment to sustainability (Rathore et al., 2020).

### **3 Method**

The following chapter will describe the methodology that has been used in this research, including the research design and processes applied in the methodology.

#### **3.1 Research context and mechanism**

Food waste is a global concern from many perspectives, Environmental, ethical, and economic. Developing sustainable and eco-friendly solutions are crucial nevertheless for all kind of enterprises to contribute improving their processes in the business.

This study examines how to improve the logistics chain in the food supply chain and how to minimize food waste using lean principles and a green thinking approach. The study also examines how to add more sustainable value to a product. The study is Initiated by a small company in the food industry, and therefore the study is made from a small and medium-sized business perspective.

The study started with a meeting with a representative from the case company, and the topic with its research questions was defined. The next step was to set up a research proposal, including a preliminary schedule including a timeline for the study. After the research proposal was accepted, it was turned into a research plan, and research questions had a secondary review to see their fit to the research.

### **3.2 Research method**

Qualitative study is a general term that applies to a subset of sampling techniques that do not depend upon quantitative analysis or mathematical analysis that generate results (Hamilton & Finley, 2019).

Qualitative and quantitative analysis are significantly different in terms of nature and methodology, and thus a similar concern is if qualitative research may or can be measured using same criteria as quantitative studies, or if it requires both its set of guidelines (Lindgreen et al., 2021).

The research was qualitative research, including a survey and interview with food industry producers. Google form was used when creating the survey and contacted the food producers mainly via Facebook messenger and e-mail. The tables and figures were created with Microsoft Excel.

### **3.3 Survey and interview**

The target group for the survey and interview was employees and executives working in the food industry, furthermore food production, food processing, and retailing. A survey was used with pre-made questions that were essential for conducting this research. The survey consisted of multiple-choice questions and questions created with a Likert scale. Additionally, questions were included where the user could answer freely to the question.

Qualitative study is roughly described as the collection and interpretation, non-numerical information, although there are several differing meanings.

A far more condensed interpretation characterized qualitative analysis as an ongoing process where the academic community gains a better description of the phenomenon being examined by creating a new contextual way as a consequence of edging closer towards the phenomenon of interest (Thelwall & Nevill, 2021).

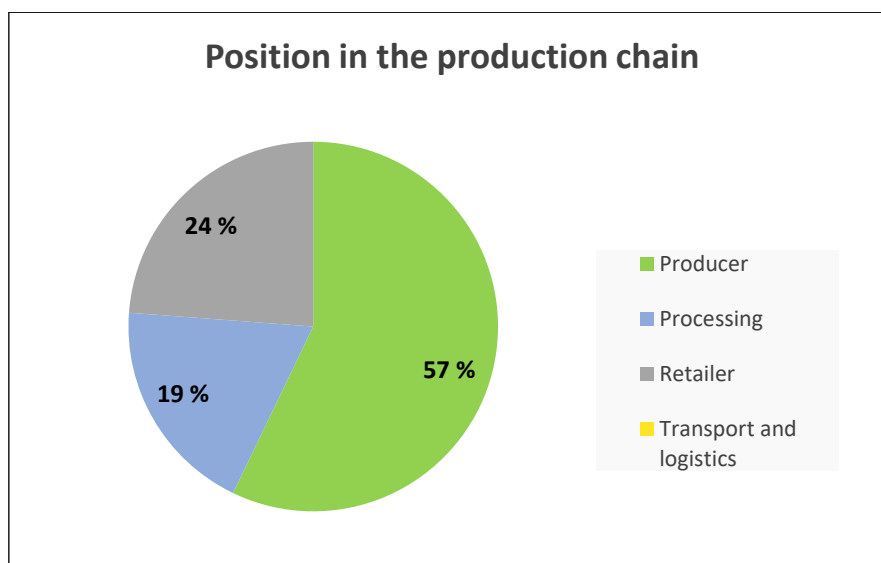
## 4 Results

In this chapter, the results of the survey and interview is presented. The number illustrated in the figure and table images below explains the question order of the survey, and the results will be presented accordingly to give the reader a structured and good understanding.

### 4.1 General data and production overview

To ensure an accurate view and in-depth understanding of the companies that took part in the survey, it is vital to iterate their position and role in the food industry, furthermore to provide accurate results and to get a better understanding of the case problem itself.

Figure 13 below illustrates the role in the production chain of the survey participants.

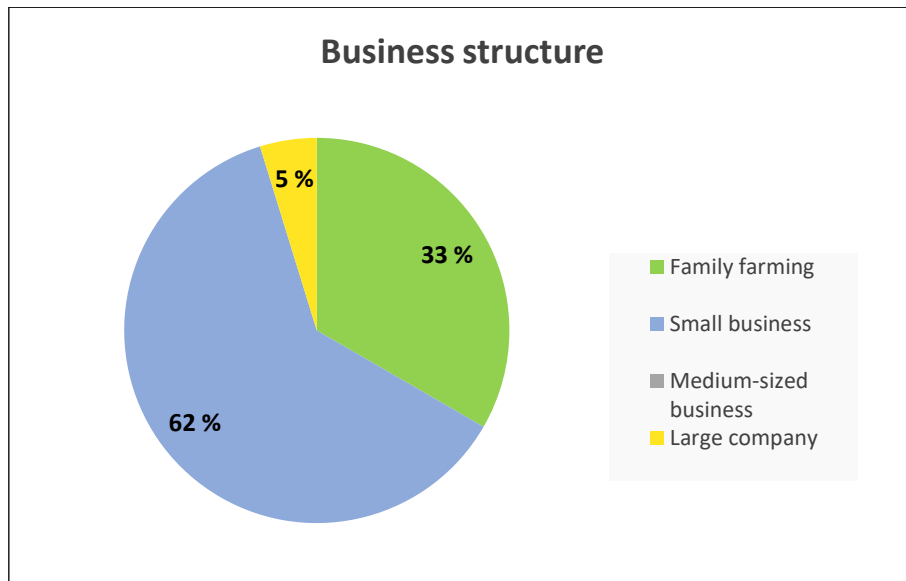


**Figure 13.** Survey participant's position in the production chain.

As the figure illustrates, slightly half over the survey participants have a role in the food production chain and a quarter deals with retailing furthermore we can conclude that almost 20% of the participants have a role in food processing. The role mix in the food

industry will cover the questions from a broad perspective since they will contribute with their expertise in the food industry sector.

Participants in the survey were asked what business structure they operate, answers as small businesses, family farming, and significant company answers were obtained. Figure 14 below will illustrate the distribution of the participant's business structure.

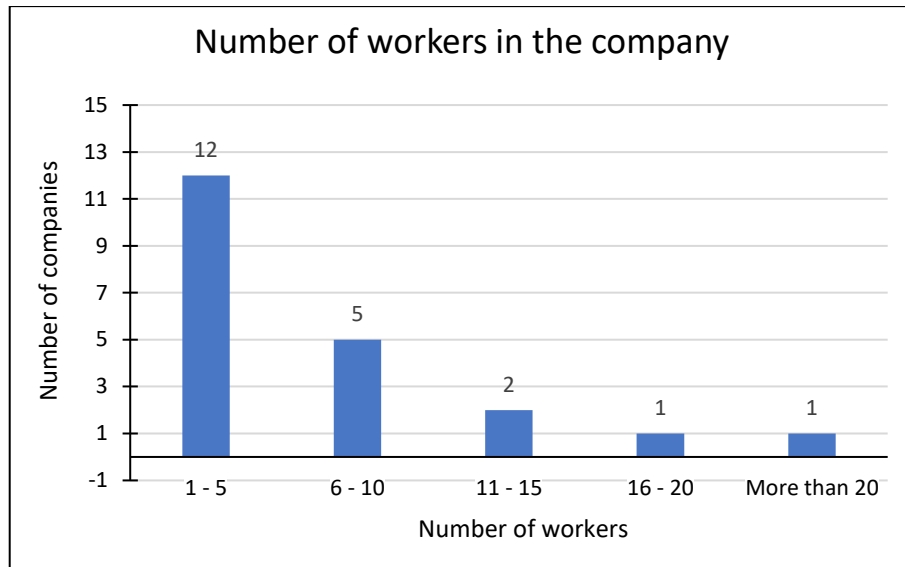


**Figure 14.** The Business structure of the survey participants.

In Figure 14, we can conclude that the majority operate a small business structure and a third have a family farming business. Nevertheless, the figure also illustrates that a small part represents a large company structure. With the help of Figure 14, it can be correlated that the majority of the text answers will be represented by small business entrepreneurs. By this mentioned, the answers could be closely compared with the case company, which is a small business.



Figure 15 below illustrates the distribution of the number of workers in the company.

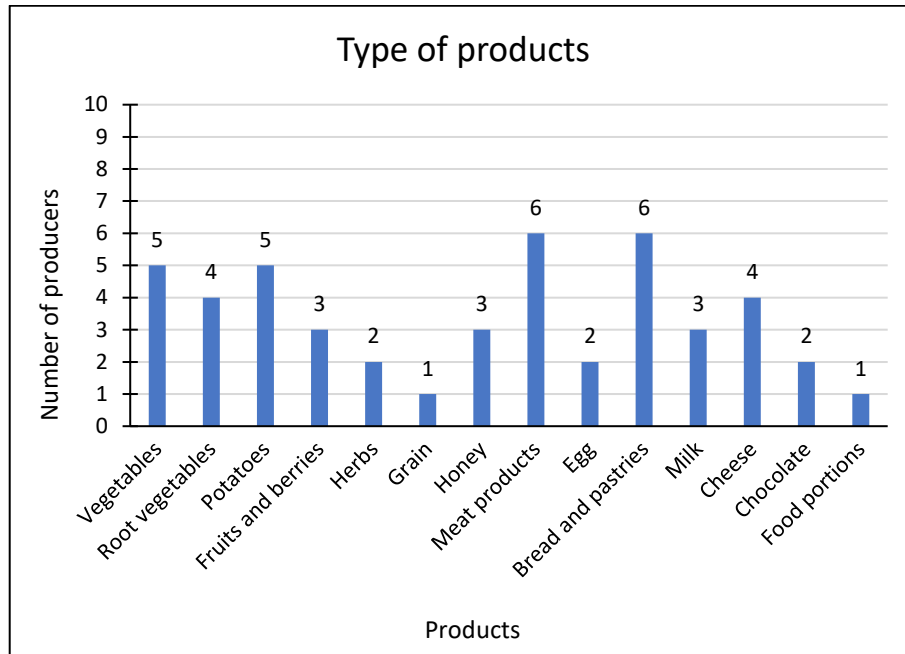


**Figure 15.** Number of workers in the survey participants companies.

As illustrated in Figure 15, it correlates well with Figure 14 as we can conclude that the majority of the workers in the survey participants companies are 1 to 5. From Figure 15, it can be concluded that nearly the other half represents an operating workforce of 6-10 employees. From Figure 15, it can also be seen that a slight majority of the workers in the food production and retailing companies present a larger workforce above 10.

However, comparing the result of figure 15 to the result of Figure 14, a third of the survey participants represents a medium-sized family farm, and therefore Figure 15 indicates that the workers above 10 belong to the family farm and large company businesses.

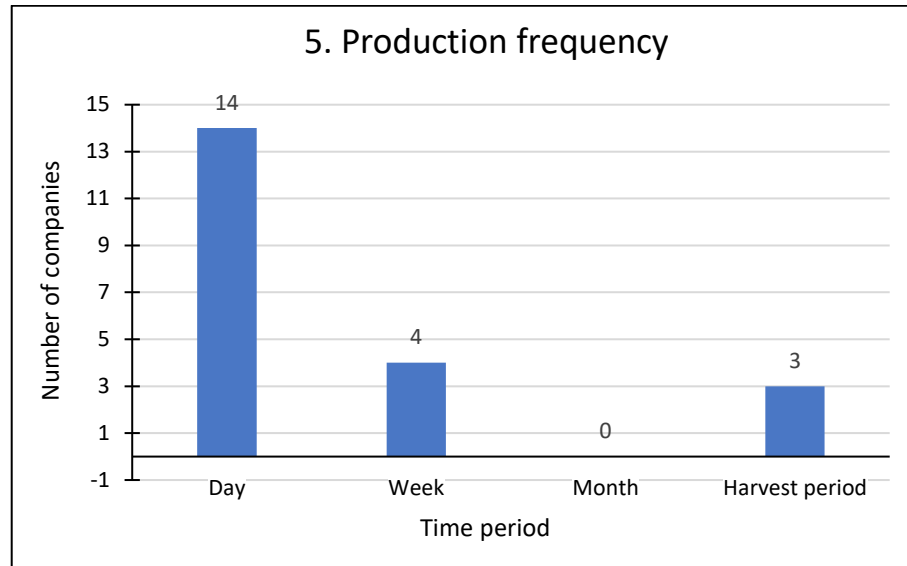
The food industry contains a large number of products and different types of products, and Figure 16 below illustrates the production distribution of the product type.



**Figure 16.** Type of products that the survey participants produce.

Distribution of the products is quite equal, with a few exceptions such as grain, herbs, egg, chocolate, and food portions which have a smaller role in the type of products produced. Meat products, bread, and pastries, potatoes, and vegetables share almost an equal number of the products being produced in the food industry. As Figure 16 depicts, there is a large variety of different products being produced. Furthermore, it gives a wide and significant coverage from various perspectives in the survey.

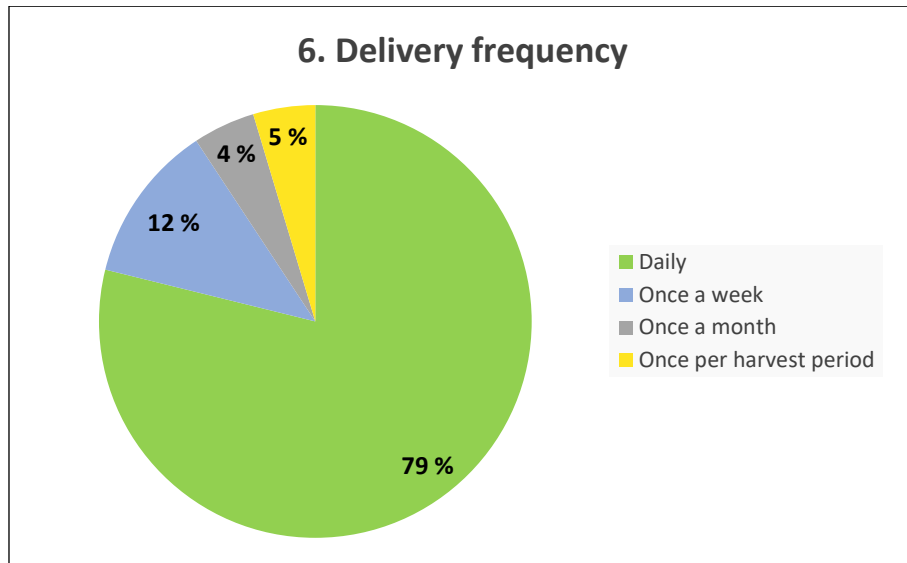
The Production frequency of the survey participants companies is illustrated in Figure 17 below.



**Figure 17.** Production frequency of survey participants companies.

Figure 17 illustrates that a majority of the food producers have a production frequency on a daily basis, which grants good possibilities on the food supply chain, and it can contribute to a delivery demand on a daily basis. A quarter of the participants answered that they operate on a weekly basis which guarantees a weekly delivery.

Figure 18 below illustrates the delivery frequency.

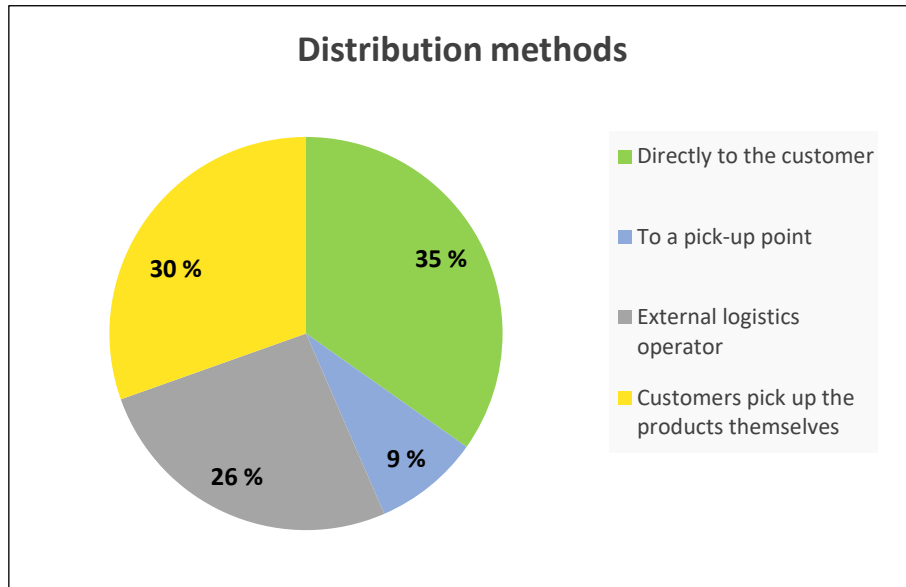


**Figure 18.** Delivery frequency of the survey participants operating companies.

As Figure 18 illustrates, a large majority of the food industry operatives have the possibility to deliver on a daily basis which correlates well with the results in Figure 17.

To be noticed from Figure 18 is that a small part of the survey participants answered that their delivery frequency is only once per week, and the survey participants also commented that they could only deliver once per month, furthermore a small amount of the survey participants stated that they could deliver once per harvest period.

Participants were asked which distribution method suits them best, and the results are shown in Figure 19 below.

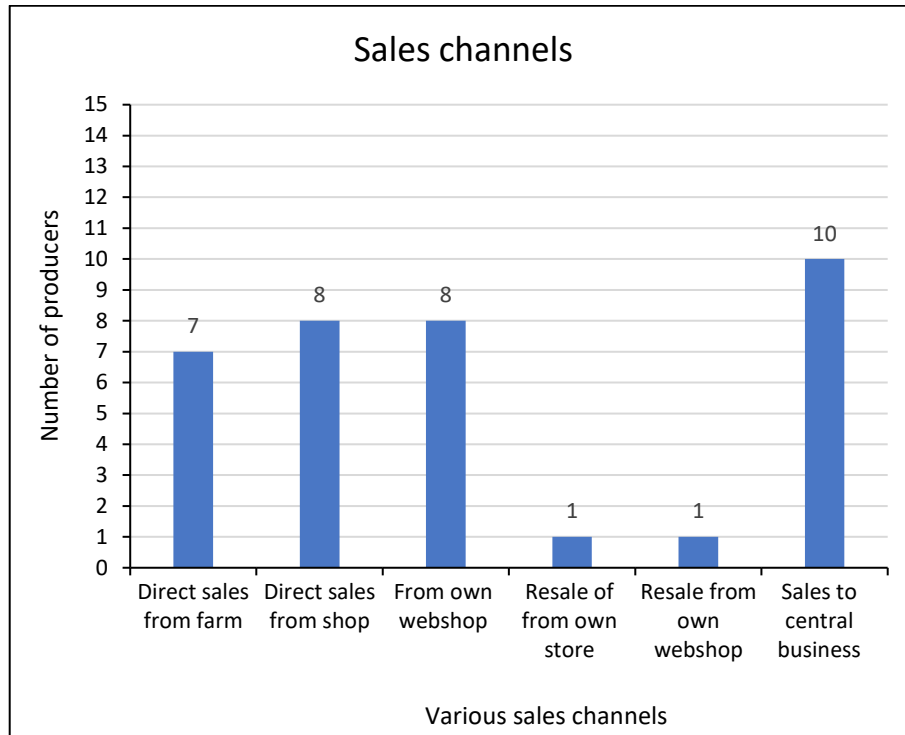


**Figure 19.** Distribution methods of the survey participant companies.

We can conclude from Figure 19 that almost equally three methods are the most common for the food producers, direct delivery to the customer, External logistics operator, and customers pick up the products themselves. A small number of operating companies use a pick-up point for the customers.

As Figure 19 depicts, the survey participants offer a large variety of distribution methods which grants some flexibility from the retailer perspective and therefore contributes to innovative solutions among the food producing and retailer chain.

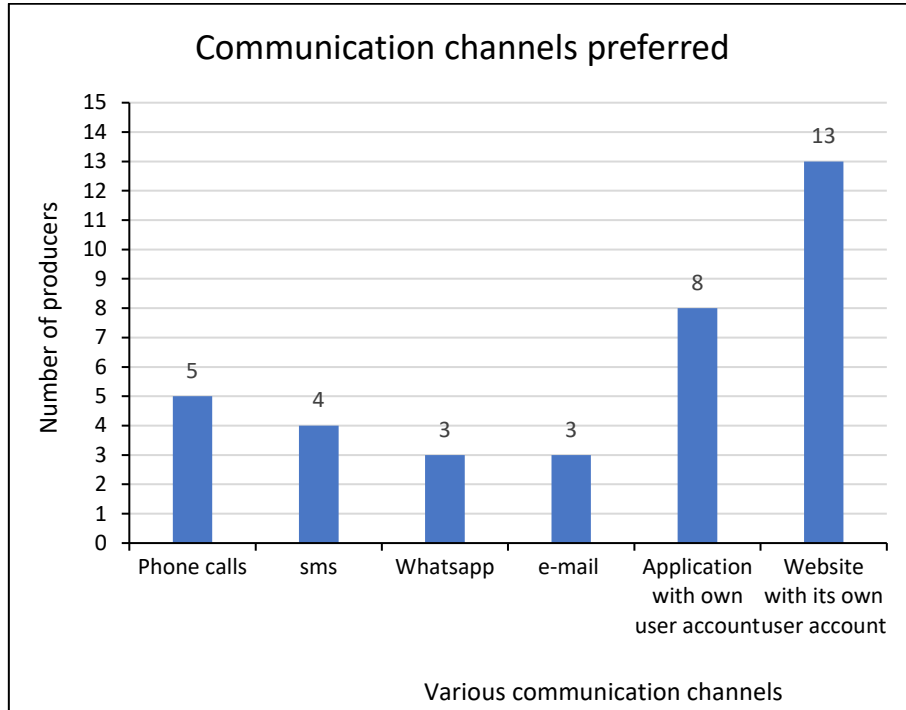
The survey participants were asked what sales channels they use, and the results are illustrated in Figure 20 below.



**Figure 20.** Sales channels of the participant's food companies.

The distribution of sales channels is equal with the exceptions of resale of own store and resale from own webshop, and current trends indicate that the most popular sales channel option is the sales to central business which then distributes the products to a larger store. To be concluded from Figure 20 is also that the digitalization has taken a larger part since 8 of the participants also replied that their sales channel is from own webshop, furthermore comparing to the answer 10 of sales to central business versus eight from own webshop, the numbers are quite even, and by this figure we can conclude that the role of digital solutions are gaining a larger role in the decision of sales channel to be used.

The survey participants were asked the question of which communication channel they prefer to use. The results are illustrated in Figure 21 below.



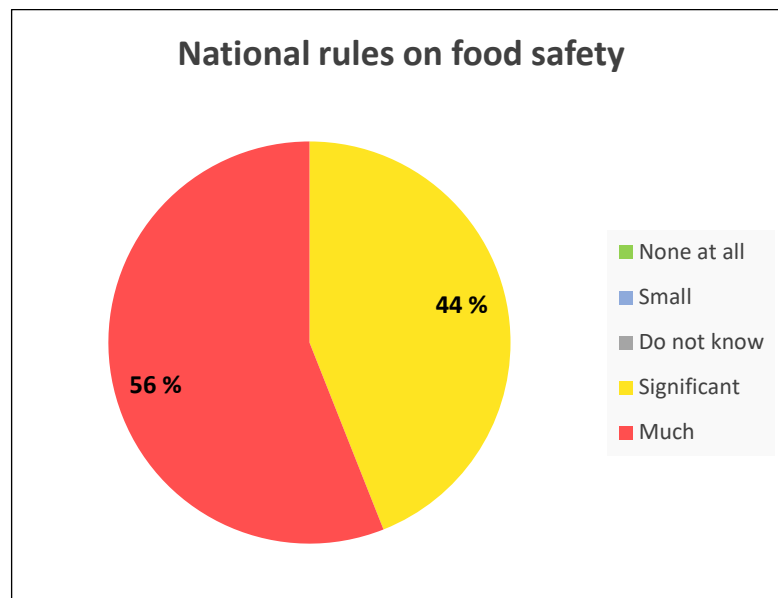
**Figure 21.** Preferred communication channels among the survey participants food companies.

From the Figure 21, a significant trend of digitalization have taken a significant role in the communication, older methods such as phone calls and SMS are less wanted than digital solutions such as application with own user account and website with its own user account. From Figures 20 and 21, we can conclude that digitalization is taking a more significant role in the small businesses in the food industry, and with those tables, it can be said that the solutions for today's challenges in the small businesses in the food industry should strive to be more digital-based.

## 4.2 Factors and impacts affecting the food production and distribution chain

In the survey, the participants were asked to place a weight on the factors affecting the food production and distribution chain. Furthermore, a Likert scale from 1 to 5 was used, on national rules on food safety, 1 = Not at all, 2 = Small, 3 = Do not know, 4 = Significant, 5 = Much.

Figure 22 illustrated below asked the survey participant companies about their opinion on national rules on food safety.

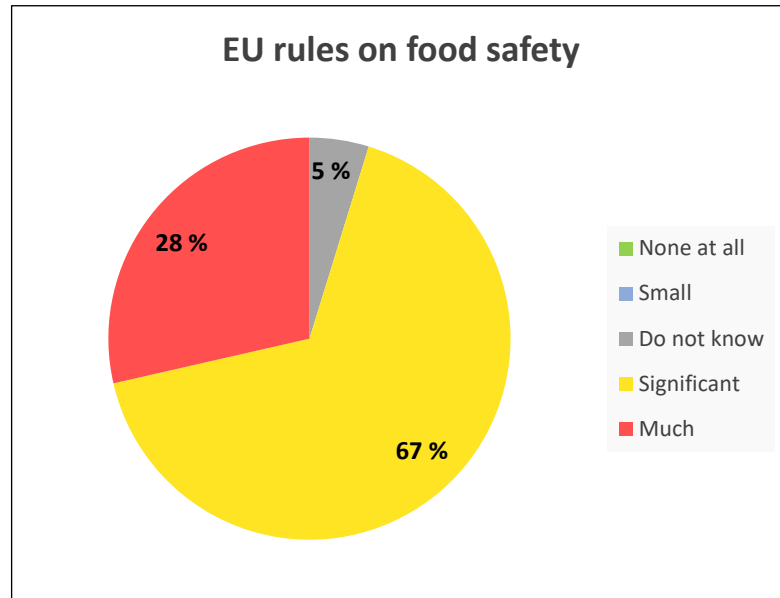


**Figure 22.** National rules on food safety among the survey participant food companies.

National rules regarding food safety play a crucial role in the food industry. As Figure 22 illustrates, a slight majority of the survey participants claim it has much impact on the food industry, and the minor half claim it has a significant impact. From Figure 22, it can be determined that national rules regarding food safety do not play a small role or none at all. Therefore food industry needs to take the food industry rules into sensitive consideration when designing the production of food products.



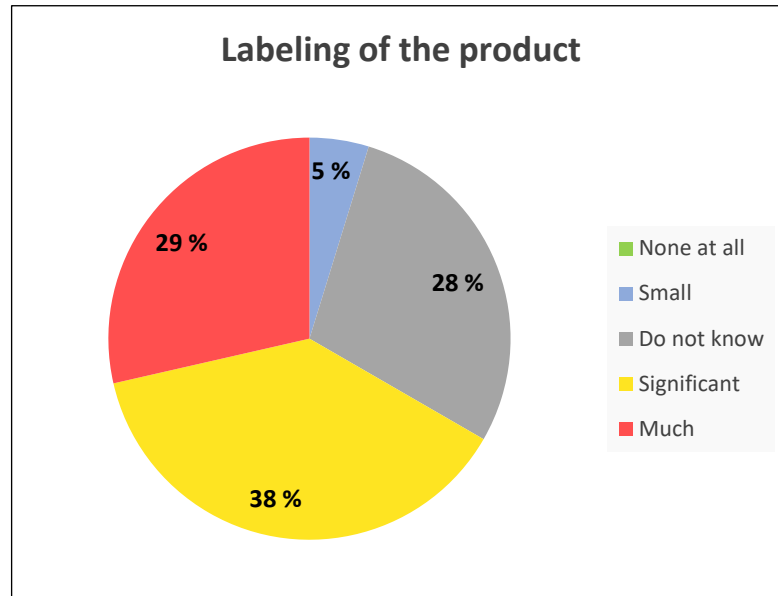
Nevertheless, also EU rules play a significant role in the food industry, as illustrated in Figure 23 below.



**Figure 23.** Impact of EU rules on food safety among survey participants.

As illustrated in figure 23, EU rules on food safety play a significant role in the food industry among the survey participants. However, nearly a third also tells the EU rules to have much impact on their operating businesses.

Labeling of the products have a divided impact among the operating organizations. The distribution of the factors is illustrated in Figure 24 below.

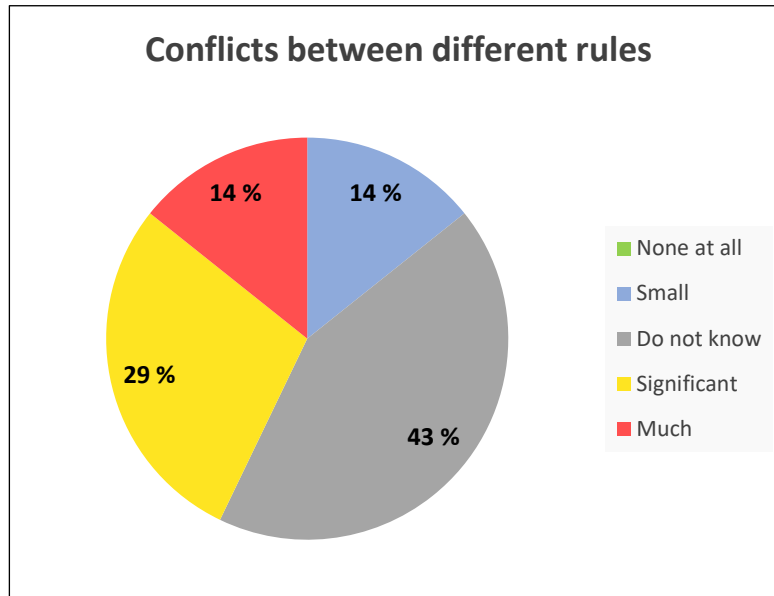


**Figure 24.** Impact of labeling the products among survey participants.

The product labeling in the food industry organizations has a divided impact on the production and distribution chain. Furthermore, we can determine that nearly over third claims the product labeling has a significant effect on the organization's activities.

Slightly a bit under a third of the food industry organizations claims that it has much impact on their organizational performance, however from Figure 24, it can be observed that another third cannot determine if it has an effect on the organizational performance. A small minority answered that it has a small impact on their organizational performance.

The survey participants were asked to determine the impact factor of conflicts between different rules. Distribution is illustrated in Figure 25 below.

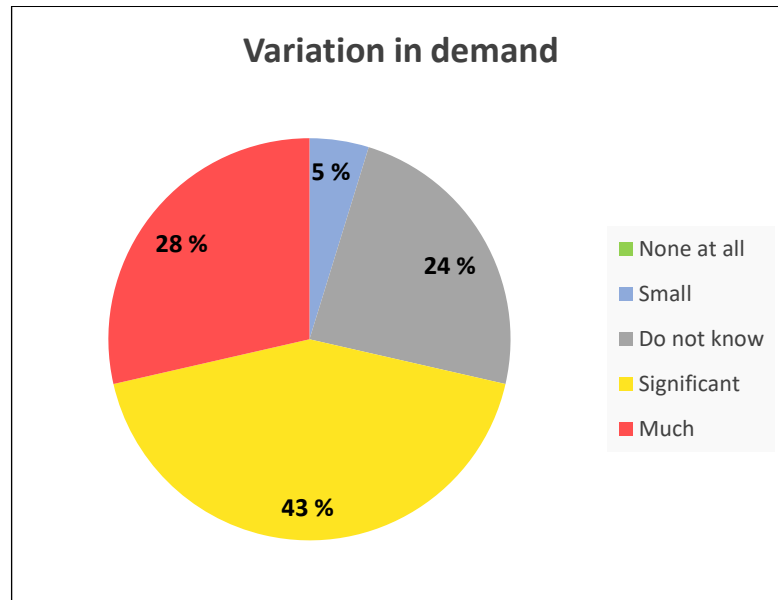


**Figure 25.** The conflict between different rules on the organizational governance among the survey participants.

As Figure 25 depicts, a majority do not know if there are conflicts between different rules in the food industry, Figure 25 highlights that almost the other half of participants emphasize that the conflicts between different rules have much or significant impact on the organizational governance in the food industry.

Conflicts between different rules, as illustrated in Figure 25, tend to cause a lot of bottlenecks in the food production and distribution chain stated among the survey participants.

The demand variation in the food industry among the survey participants has much or significant effect on their organizational activity. The factor impact distribution is illustrated in Figure 26 below.

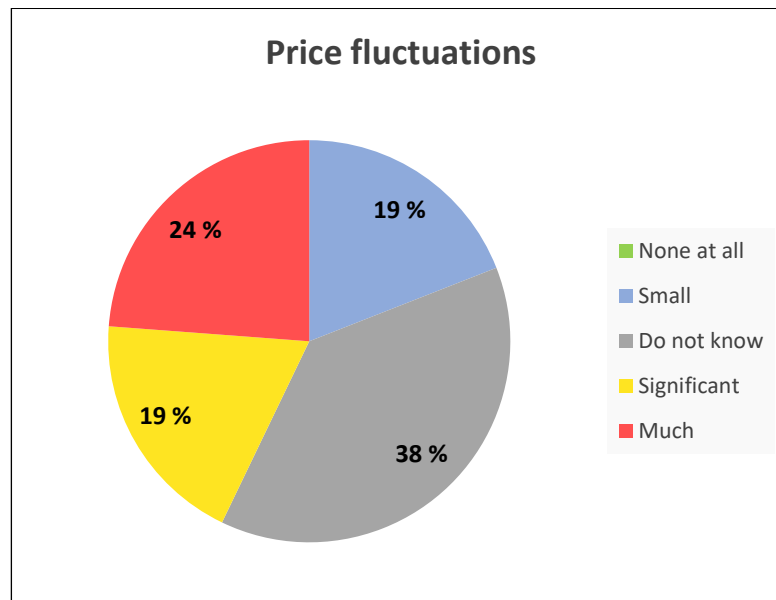


**Figure 26.** Demand variation effect on the organizational activity among the survey participants.

The vast majority of the survey participants claim the demand variation has much or significant impact on the food production and distribution chain. However, we can notice that a quarter of the survey participants do not know if the demand variation affects their business.

Among the survey participants, especially bread and bakery producers, indicated that demand variation and trend variation cause challenges in the production planning in food production and distribution chain.

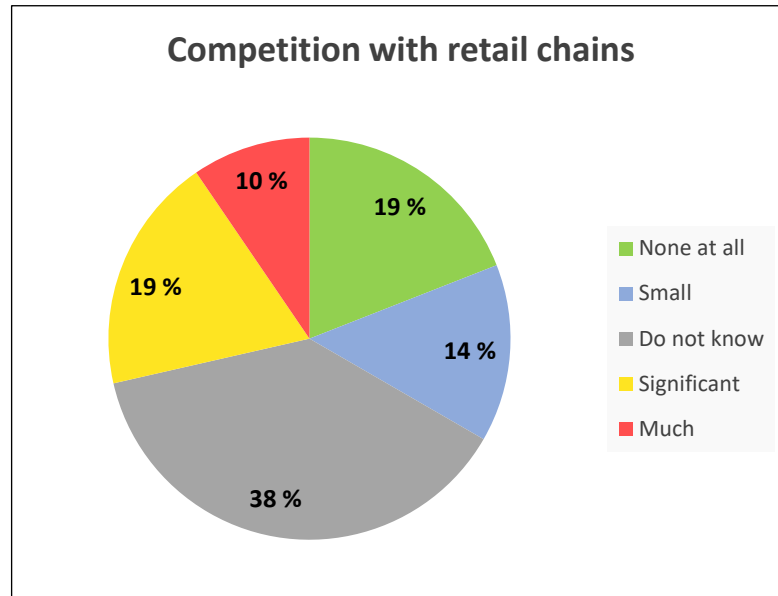
Factors like price fluctuations tend to have an impact on the food industry, especially in the production units. However, a majority of the survey participants did not know if it had an impact on their business, the factor distribution depicted in Figure 27 below.



**Figure 27.** Impact of price fluctuations in the food industry among the survey participant's businesses.

Figure 27 illustrates that a small majority states that they do not know if and how price fluctuations affect their organizational activities. However, a large part of the survey participants states that the price fluctuations tend to have a big impact on their production and distribution activities in the food industry.

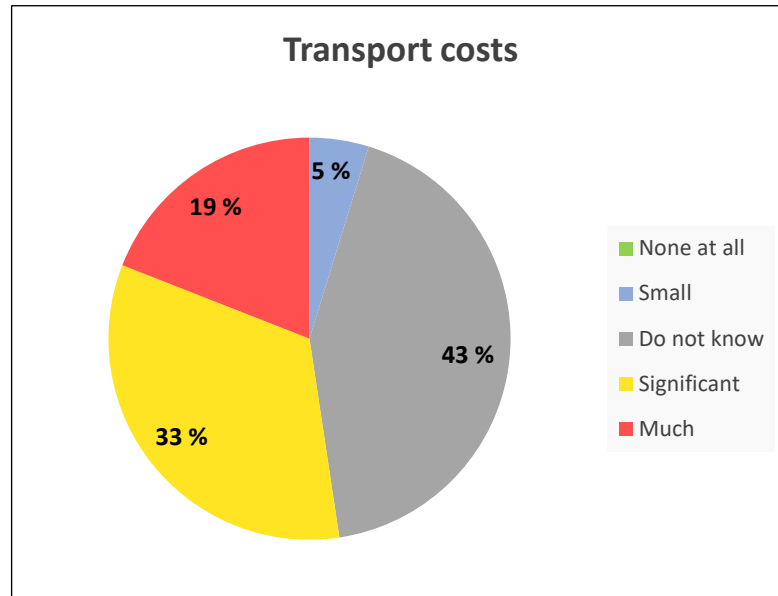
Survey participants were asked about the competition with retail chains and its impact on their businesses. The distribution is illustrated in Figure 28 below.



**Figure 28.** Competition with retail chains impacts food production and distribution chain among the survey participants.

As Figure 28 depicts, the majority of the survey participants do not know if the competition with retail chains is affecting their businesses. From Figure 28, it can also be seen that nearly a third of the survey participants state that the competition has much or significant impact on their organizational activity. However, slightly under a fifth states that it has a small impact on their business.

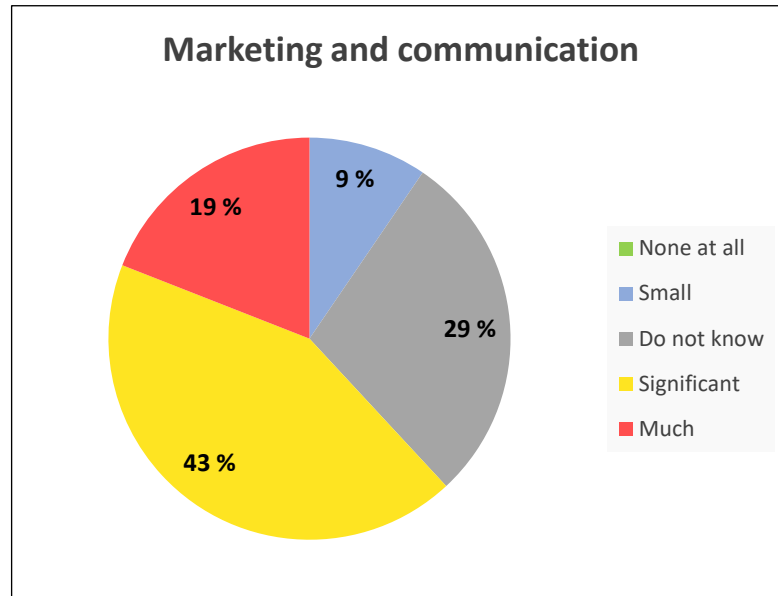
In the survey, the participants were asked about the impact of transport costs. Factor distribution is illustrated in Figure 29 below.



**Figure 29.** Factor distribution on transport costs among the survey participants.

In Figure 29, the minority of survey participants stated that they do not know if the transport costs are affecting their business, furthermore Figure 29 illustrates a small majority claims that the transport costs have much or significant impact on their organizational activities and businesses in the food industry, however, a small amount of the survey participants claim the impact of transport costs have a small effect on their organization.

Participants in the survey were asked about the impact factor on marketing and communication. The distribution of answers is depicted in Figure 30 below.

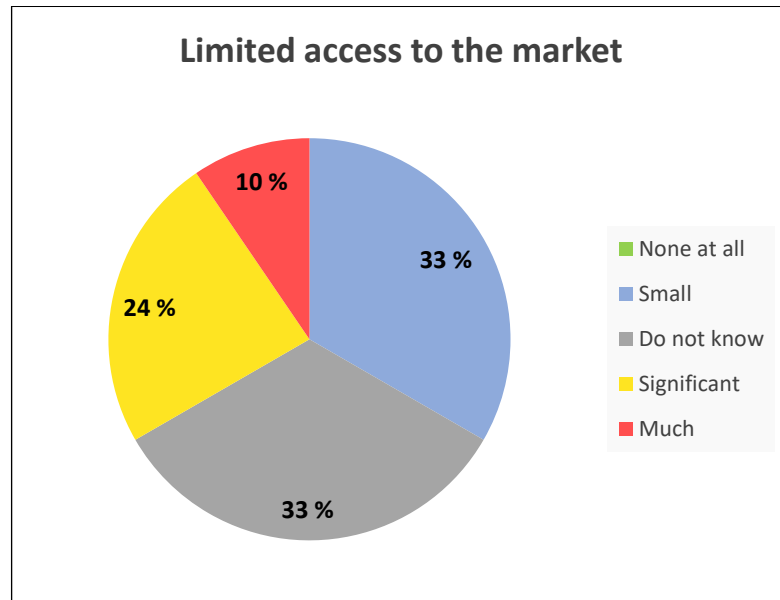


**Figure 30.** Impact factor on marketing and communication among the survey participants.

Marketing and communication impact factors depicted in Figure 30 illustrate that a majority of the survey answers that marketing and communication have much or significant impact on their organizational administration. Furthermore, Figure 30 depicts that a third of the survey answers do not know if marketing and communication have an impact on their role in the food industry and distribution chain. However, Figure 30 depicts also that a small part of survey answers claim that marketing and communication have a small impact on their business.



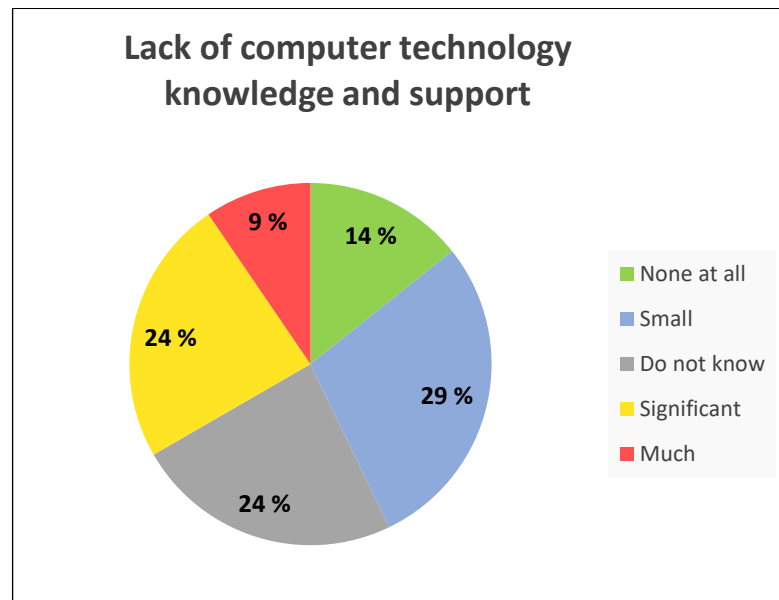
The survey participants were asked to indicate the impact factor on their business by limited access to the market. The answer distribution among the survey participants is illustrated in Figure 31 below.



**Figure 31.** Impact factor of the limited access to the market among the survey participants.

Figure 31 depicts three divided opinions on the impacts of limited market access among the survey participants. A third of the survey participants do not know if the limited access to the market is affecting their business. However, one-third of the survey participants indicate that it has much or significant impact on their organization. Furthermore, also a third of the survey participants state that the limited market access has a small impact on their business activities.

The survey participants were asked to indicate their opinion regarding the lack of computer technology knowledge and support. The answer distribution on the impact factors is illustrated in Figure 32 below.



**Figure 32.** Impact factor regarding lack of computer technology knowledge and support among the survey participants.

As Figure 32 illustrates, slightly over the third of the survey participants indicated that it has much or significant effect on their organizational administration. Furthermore, figure 32 depicts a third of the survey participants stated that lack of computer technology knowledge and support have a small impact on their business activity. However, a small amount of the survey participants stated that it has no impact at all.

### 4.3 Sustainability in food supply chain and delivery

The food industry representatives that took part in the survey were given the opportunity to write freely regarding sustainable food supply chains and to determine what actions should be taken to grant sustainability in the food supply chain and how an effective supply chain could be created.

The survey participants were asked how long do the food products last from the packaging, results illustrated in Table 1.

	1 hour	1 day	2 - 7 days	2 weeks	3 weeks	1 month	2 - 3 months	4 - 6 months	1 year	More than 1 year
Vegetables				xxxx	x					
Root vegetables				xxxx						
Potatoes				xxxx					x	
Fruits and berries				xxx						
Herbs				xx						
Grain								x		
Honey										xxx
Meat products			x				x		xx	xx
Egg				xx						
Bread and pastries		xxxx	xx							
Milk			xx	x						
Cheese							xx		xx	
Chocolade									xx	
Food portions	x									

**Table 1.** Duration time of food products.

The major part of the food products grants a good duration as depicted in Table 1, after packaging but also how the client is storing the product is affecting the duration of the product, and products that require specific action by the customer regarding storage

should be well informed to the client. To be concluded from these answers is that the prediction among the survey participants regarding food storage is that most food producers can grant good durability on the products after the packaging phase. However, there are some food products that last a short time, such as daily fresh products and products with a durable time of 1-5 days after packaging. From these answers, it can be stated that different food products have different duration times after packaging, and this should be taken into consideration for the sme retailer when making ordering the products.

In the survey, the participants were asked how large amounts of products they can deliver, results illustrated in Table 2 below.

	100 kg/year	1 000 kg/year	5 000 kg/year	10 000 kg/year	100 000 kg/year	500 000 kg/year	More than 500 000 kg/year
Vegetables		xx	xx	x			
Root vegetables		xx	x	x			
Potatoes			x	xxx	x		
Fruits and berries		x	x	x			
Herbs	xx						
Grain				x			
Honey	x	xx					
Meat products		xxxx					xx
Egg			xx				
Bread and pastries		xx	xxx	x			
Milk			x		xx		
Cheese		xx	xx				
Chocolade		xx					
Food portions				x			

**Table 2.** Delivery amounts.

The amounts that can be delivered are significant as Table 2 depicts and this grants the possibility for the retailer to make scheduled orders and not to buy too much at once. Furthermore, the demand and supply in the food industry have the possibility to collaborate well with each other.

The survey participants were asked what kind of possibilities they have regarding the storage of their products, results are illustrated in Table 3 below.

	0 kg	100 kg	1 000 kg	10 000 kg	More than 10 000 kg
Vegetables	x	x	xxx		
Root vegetables		x	xxx		
Potatoes		x	xx	x	x
Fruits and berries		xx	x		
Herbs	x	x			
Grain				x	
Honey		xx	x		
Meat products		x	xx	xx	x
Egg		x	x		
Bread and pastries	xxxx	xx			
Milk		xx	x		
Cheese		x	xxx		
Chocolade		xx			
Food portions	x				

**Table 3.** Product storage possibilities.

Overall the food producers and retailers have good prerequisites to store food products. Furthermore, they have large warehouses, which grants a good storing opportunity, though with a few exceptions, such as bakery producers that mainly work with fresh products.

The next question that survey participants got to answer was which possibilities they have to grant good sustainability.

A few survey participants producing meat products commented:

*"Good prerequisites"*

*"Good possibilities"*

*"Before there was a lot of waste, but now we have investigated that when deep-frozen, our smoked products do not change taste and texture either, so we now have cold storage and very good shelf life"*

The meat producer participants have discovered that freezing the smoked meat products are not changing texture or taste and therefore grants a good storage and shelf life.

One survey participant working with chocolate processing replied:

*"Good"*

A few survey participants producing bread and bakery products commented:

*"Some (eg, sourdough bread) last a long time"*

*"Most people probably want the bakery products to be fairly freshly baked"*

As survey participants stated, bakery products such as sourdough bread last a long time.

Nevertheless customers want the bakery products daily fresh.

One survey participant with herb production answered:

*"None, because they do not have a long shelf life and must be harvested at a certain time, and I can work with sustainable raw materials and locally produced"*

Herb production does not have a long shelf life, and therefore it has to be harvested at a certain time. It is also said that the producer can work with sustainable raw materials that are locally produced.

One survey participant with grain production replied:

*"dried grain is well preserved"*

A survey participant working with retailing of bread and bakery and food portions commented: *"A restaurant product is guaranteed fresh when you bring it from the restaurant"*

One survey participant working with vegetable production commented: *Advice to those who buy to store the salads in a plastic bag in the fridge"*

A retailer working with potatoes, vegetables, honey bread and meat products commented: *"We run in products week by week, which gives good durability. Products are needed to be frozen"*

A survey participant producing milk and cheese products replied: *"within the general limits of dairy products, it is possible to guarantee. we do not use additives"*

Survey participant stated that dried grain is well preserved, furthermore another survey participant stated that a restaurant product is guaranteed fresh. A survey participant with vegetable production stated that advising customer to store the salad in plastic bag guarantees a longer lifetime for the product. Nevertheless, a retailer working with potatoes, vegetables, honey bread and meat products brought up the possibility of freezing products which grants a longer duration of the products.

The survey participants were asked what factors, if any, prevent the establishment of a smooth food supply chain.

A survey participant running a milk production business answered:

*"A lot of bureaucracy"*

A survey participant working with meat processing commented:

*"None really"*

A survey participant working with meat and honey processing answered

*"do not know"*

A survey participant running a bakery replied:

*"Maybe if you can not cooperate"*

A survey participant producing herbs commented:

*"Product durability and the varying demand. Risks of growing too much or too little are great. Which means risk of overproduction, ie that it is thrown away"*

A survey participant producing bread and bakery products commented:

*"Mainly that it is difficult to know volumes needed per day, that it will be over at the end of the day"*

A survey participant retailing vegetables, potatoes, fruits and berries, honey, meat products, egg, milk, cheese and chocolate replied:

*"Poor marketing of producers"*

Another survey participant retailing vegetables, root vegetables, potatoes, fruit and berries, honey and eggs commented:

*"Most are centralized for large-scale operations, which creates a lot of transport and expensive facilities"*

As survey participants indicated bureaucracy is a barrier between the creation of a smooth food supply chain, a few of the survey participants did not know what should be done, nevertheless answers like cooperation among the answers was said that should emphasize a smooth food supply chain. It was also stated among the survey participants that product durability and varying demand causes challenges in the establishment of a smooth food supply chain. Among the survey participants also the marketing role of the producers was lift out as an issue in the establishment of a smooth food supply chain.

The survey participants were asked of there are other significant factors that affect the work of the food producer.



The food producing survey participants commented:

*"Now in these times of course corona"*

*"Legislation and various trends"*

*"It is stressful work"*

*"Consumer knowledge about food has deteriorated, most are delivered as "ready-made food"*

*"Free individual advice in law, digital marketing, finance"*

*"A food strategy that no authority needs to fulfil"*

The survey participants were asked to make comments on their own ideas how to develop a sustainable food chain?

A few survey participants commented:

*"It is probably a good collaboration that applies"*

*"Shorten transport distance between ground and table. Better collaborations to find a steady demand"*

*"More bookings/subscriptions for bread and pastries and less spontaneous purchases make it easier for the baker to know quantities to bake"*

*"Rebuild the line from producer - » Packing - » shipping - » Consumer = smaller stock, shipping km"*

*"no taxes and government fees until the food producer starts to make a profit"*

Factors effecting the work of food producers among the survey participants were challenges caused by covid-19 pandemic, nevertheless one survey participant stated that the consumer awareness and knowledge of food has disoriented and that the most are delivered as ready-made food.

Among the survey participants there were also wishes of free law advice but also advices in digital marketing and finance. Among the survey participants it was also said that more pre-orders and less spontaneous purchases would contribute to a smooth food supply chain.

The survey participants also indicated that the line from producer to consumer should be rebuilt as producer-shipping-consumer which results in smaller stock and shipping kilometres for the food product. Among the survey participants it was also said that there should be no taxes on food products until the food producer starts gaining profit.

The survey participants were asked how could the cooperation between the producer and the dealer be developed?

A few survey participants answered:

*"A little hard to say as I sell everything myself"*

*"Time and opportunities (interest) for discussion between the parties"*

*"Regular meetings"*

*"More active sales by the producer"*

*"Digitize more and with apps make companies run more smoothly together"*

*"Through regional collaborations within orders, distribution, transshipment center"*

*"Common state portal - where everyone meets"*

*"Through personal contacts"*

The survey participants stated that the development of cooperation between parties could be improved in regular meetings and more active sales by the producers. Also the survey participants corresponded that increased sales activity by the producer could be a factor that enhance the relationship between producer and dealer.

The survey participants also said that more digitalisation solutions should be brought up as a solution to the cooperation between producer and dealer. The survey participants also said that regional collaboration within order, distribution and transshipment center could be a milestone in developing the cooperation. The survey participants also said that creation of a common state portal where everyone meets could be one way of making the cooperation better. It was also said that personal contacts plays a role in the co-operation between producer and dealer.

The survey participants were asked how could waste be minimized?

A survey participant processing meat products commented:

*"Get consumers and understand that the best before is not the last day of consumption"*

Another survey participant producing eggs commented:

*"For example, Reko sales, which I am an ardent advocate of (admin in Reko Närpes) actually completely minimizes waste as all products must be ordered in advance by the customers"*

Another survey participant processing meat products replied:

*"There are many ways, purposeful production and well-thought-out utilization of the waste for other uses"*

A survey participant running chocolate processing commented:

*"Do not create waste and take advantage of what is created"*

A survey participant producing herbs answered:

*"The longer the shelf life of the product, the greater the probability that it will be "sold" and not thrown away. Therefore, one should invest in more locally (and not all via different central warehouses). Reduce the risk of overproduction by listening to the market and if there are risks of overproduction, help to highlight the products to customers and help to show how different products can be used"*

A survey participant producing bread and bakery products answered:

*"I take advantage of most things, freeze bread that can be sold at a discount if it should run out another day. Make crusts from buns etc, I throw away minimal bread and pastries. I also donate some that goes to animal feed. My customers understand that it can end before closing some days because I do not want to overproduce"*

A survey participant with vegetable production answered:

*"We are aiming to create our own fish food (using insect larvae and/or mussels); we can feed the insects with our own vegetable waste (roots and leaves). There is very little*

*waste in an aquaponic system such as ours where the fish waste becomes nutrients for plants which clean the water before it is returned to the fish, but the fish food we need to buy is not sustainable (contains soy amongst other things)"*

A survey participant retailing vegetables, potatoes, fruits and berries, honey, bread and bakery products commented:

*"Pack / produce what is ordered no more. Works best when the system is digital"*

Another survey participant producing vegetables, root vegetables and potatoes replied:

*"We also sell root vegetable waste such as horse and animal feed. What is left, such as cabbage tops and other things when trimming, goes to animal feed and game feeding on the farm"*

A survey participant producing honey and cheese commented:

*"Depends on what products we mean. We have found a way to freeze items that do not change and items that could not be frozen - we have removed them from production to avoid food pigs"*

Another survey participant producing meat and cheese products answered:

*"Best after labeling on aged cheese. To offer tastings and cook products where dates are about to expire"*

The survey participants were asked if they have other opinions, one survey participant replied:

*"There should be some opportunity to get in touch with both wholesalers and restaurant chains through the same portal - preferably government so that everyone knows it and everyone who has a food approval number can register there for free. It is a very big problem for smaller food producers to get in touch with other and especially larger players in the market"*

The survey participants had many different opinions on how to minimize food waste, one opinion among survey participants was to get the consumer to understand that the

best before date do not mean that the food product could not be used. Comments among the survey participants was that sales via reko rings grants zero waste since every product is pre-ordered.

Among the participants it was also stated that meaningful production and well-thought-out utilization of the waste for other uses. Nevertheless it was also said among the survey participants to not create waste and take advantage of what is created. The survey participants also indicated that the longer shelf time the product has it increases the probability it will be sold and therefore not ending up as waste.

The participants of the survey also said that freezing the product gives more flexibility and therefore do not become waste.

A survey participant creating own fish food used their vegetable waste to feed their own insects with their own vegetable waste.

Another survey participant said that only by producing what is ordered and no more, the participant also pointed out that the system works best when digital solutions is applied. Among the survey participants it was also said that giving leftover food to animals became a solution and by that did not contribute to waste creation. However also a survey participant offered tastings on the product which was close to expire and also the possibility to cook the product which was close to expire was done.

#### **4.4 Interview with food producer and retailer**

I had a personal interview with a vegetable producer via Facebook messenger how food waste could be minimized and how the food chain from producer to end-user could be improved and the vegetable producer commented:

*"Hello I can express my two views on the problem. Firstly, there must be an end to the massive expansion of the greenhouse industry. It means an overproduction which means*

*that the vegetables are in the packing plant for up to 2 weeks before they are sold. And that's where problem number 2 comes up, it takes too long from producer to consumer. For example, a cucumber that is grown in Ostrobothnia, at first it may be in the packing house for a few days, at overproduction up to 1 week. Then it is packed and sold to large central warehouses. It is picked up by truck and driven down to southern Finland to the large supermarkets central warehouse. Then it is driven back up to Ostrobothnia to the store. Then you can ask yourself, are fresh vegetables sold in the shops? The problem is that no one has any power to influence the big central store actors, it has been going on for too long and they have total power over the market"*

To conclude from the interview with vegetable producers problem were pointed out such as producing too food products and that vegetables are in the packing place for too long and therefore affects the duration time of the food products. The interviewee also pointed out that it takes too long time for the food product to reach the end-user this because of bottlenecks in the logistics chain and the use of central warehouses.

The producer I interviewed also called for more influence on the big actors in the food industry which could result in a better food supply chain.

Another personal interview I had with a food product retailer which was oriented on the retail of food products that are close to the best before date and the company representative commented:

*"We primarily want to help people make environmentally sustainable choices. For this reason, we only sell products that need salvation that would otherwise end up in vain. We find it awful that completely usable and high-quality products are thrown away, often for minor reasons. Throwing away usable products is simply a waste of the planet's resources. We already have many wonderful customers saving food with us, but hopefully in the near future more and more will find that it is so easy to do a little good deed for the environment".*

Another interviewee with food producing and retailing business introduced an application called Hitch.

*"To become a Hitcher, you need a driver's license, a car and to register yourself via Hitch App. Fill in your vehicle details, bank account number for payments, and your driving route. You can fill in different routes according to your daily driving routines, and choose your own price per kilometre. If you fill his/her requirements for a Hitcher, you will be contacted. You can answer the request directly or communicate via Hitch chat.*

*All you need to do, is to transport the product that needs hitching, and leave it on agreed location on your route. You will receive your fee via Hitch App after you've dropped off the item"*

Furthermore the purpose of the application Hitch is to save time but also at the same time gaining some economic benefit, however the owner of hitch app indicated that this application could be a solution for moving goods between producer and retailer but at the same time it can act as a servant between retailer and consumer, with this said Hitch transport application would provide additional flexibility to delivery routines.

## 5 Conclusions

Dynamic proximities mapping supporting resilience contributing to the creativity and development of small and medium-sized enterprises.

DMAIC (Define, Measure, Analyse, Implement, Control) and DLL (Double-loop learning)

Connecting lean and green activities combination will result in improvement of organizational culture and gaining competitive advantage.

To achieve full lean, organizations should complete certain lean measures and structural mechanisms among stakeholders contributing to the improvement of the supply chain, value stream, and other work methods.

It is emphasized that the use of value stream mapping for the purpose of food loss mitigation is a powerful and productive approach.

By applying expertise within the combination of Lean and six sigma methods, the food industry is becoming stronger with more expertise.

It is also indicated that limiting value creation to small and medium-sized enterprises and combining green and lean thinking approaches in addition to value stream mapping results in an increasingly competitive level. Using the system of 5R methods (Relating, Re-engineering, Repositioning, Reacting, Reallocating) known as regarding the consumer food waste management strategies increased an environmentally sustainable value. However, it also contributed to better decision-making.

Previous studies also examined performance models for food cold chains that could avoid waste in the form of fresh products.

Studies of interdependence between Lean management, supply chain management, and sustainability from environmental, economic, and social perspectives were a sustainable solution for the inducement of environmental pollution.



The survey participants called for more digitalized solutions in the food industry. Furthermore, this would contribute to better cooperation between producer and retailer, and therefore it would contribute to increased efficiency in the food-producing and retailing chain.

The survey participants presented different duration of their products depending on the product, fresh products such as bread, milk it was promised to last for approximately one week, and for other products duration time meat, cheese and chocolate were guaranteed duration times from 1-2 years depending on if the products were frozen or not.

The survey participants had excellent prerequisites for storing and delivering products and also presented flexible solutions on additional warehouse storage if needed. Nevertheless, fast changes to the production could also be applied if the demand variation would increase.

It was stated among the survey participants that much bureaucracy stands in the way of establishing a smooth food supply chain, and they referred to national law and regulations.

The survey participants presented ideas to rebuild the food supply chain from producer to consumer to increase the sustainability factor and reduce waste.

Among the survey participants, waste mitigation actions such as get consumers to understand that the best before date does not mean the last day of use, many of the survey participants indicated that the longer durability time the product has, the large chance it is for it to be sold, furthermore ideas to process the food that was in the risk to be ended up as waste to be used for cooking and freezing the product, or feed the products close to best before date to animals on the farm.

Future works of this topic could be investigating the development of a digital solution in form of application between food producer and retailer another study could be to investigate marketing mechanisms and their development from a food producer perspective.

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## **Appendices**

### **Appendix 1. Interviewed persons**

Niklas Östman, Founder of Gårds Smak

## **Appendix 2. Questionnaire: Minimization of food waste and development of the producer-consumer chain**

1. What is your position in the production chain?
2. Business structure?
3. Number of workers in the company?
4. What type of products does your company produce?
5. The frequency of production?
6. How often can you deliver products?
7. How long do the products last from the packaging?
8. How many quantities can you deliver?
9. What opportunities do you have to store products?
10. What opportunities do you have to guarantee good sustainability?
11. Which distribution method would suit you best?
12. What sales channels do you use?
13. What type of communication would you prefer?
14. In your opinion, what are the significance of the following factors in the food chain? 1 = none at all, 2 = small, 3 = do not know, 4 = significant, 5 = much
  - National rules on food safety
  - EU rules on food safety
  - Labeling of the product
  - Conflicts between different rules
  - Variation in demand
  - Price fluctuations
  - Competition with retail chains
  - Transport costs
  - Marketing and communication
  - Limited access to the market
  - Customers' requirements and expectations
  - Lack of computer technology knowledge and support
15. What factors, if any, prevent the establishment of a flexible food chain?



16. Are there other significant factors that affect the food producer's work?
17. Do you have ideas on how to develop a sustainable food chain?
18. How could the cooperation between the producer and the dealer be developed?
19. How could waste be minimized?
20. Other opinions:
21. Contact information if you have any questions.